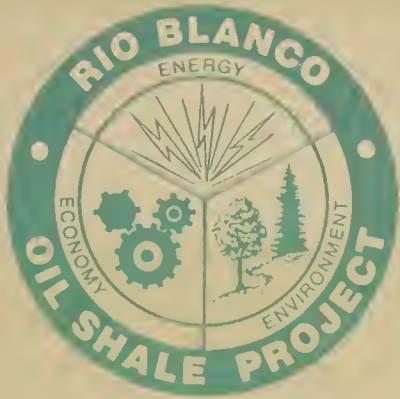


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AQUATIC ECOLOGY - BASELINE STUDIES

Submitted To Area Oil Shale Supervisor,
Geological Survey, U.S. Department of
the Interior; Pursuant To Lease No. C-20046

Gulf Oil Corporation - Standard Oil Company (Indiana)
March, 1976



AQUATIC ECOLOGY

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CHAPTER 8

AQUATIC ECOLOGY

The Rio Blanco Oil Shale Project (RBOSP) Aquatic Baseline Studies are intended to perform those environmental studies described in the Federal Register, Volume 39, Number 230, Part 3, Oil Shale Lease Environmental Stipulations; and in the Tract C-a Exploratory Plan of May 1974 as conditionally approved in the "Conditions of Approval" agreed to by letter on August 1974. Specific lease requirements addressed were "The Lessee shall make studies of the flora and fauna. . .and also of the aquatic habitat as far downstream as the Mining Supervisor shall require."

A limited variety of aquatic habitats occur on or near Tract C-a. These habitats include small springs and seepage areas, small marshy ponds, and small spring-brooks. Several miles north of the tract is the large, turbulent White River, the only true river habitat in the Piceance Creek Basin. Until the present baseline studies, no detailed studies of the aquatic ecosystems on or near Tract C-a had previously been undertaken.

The overall objectives of the RBOSP Aquatic Baseline Studies are to characterize the existing aquatic communities on and in the vicinity of Tract C-a and to inventory aquatic habitats which may be affected by oil shale development.

In order to fulfill the program objectives, a total of 35 sampling sites were selected to represent the aquatic habitats present. Emphasis in this aquatic program has been given the two permanent streams, Yellow Creek and the White River, where 18 stations have been located. The locations of aquatic sampling stations are shown in Figure 3-8-1 and described in Table 3-8-1. In this report, the stations are

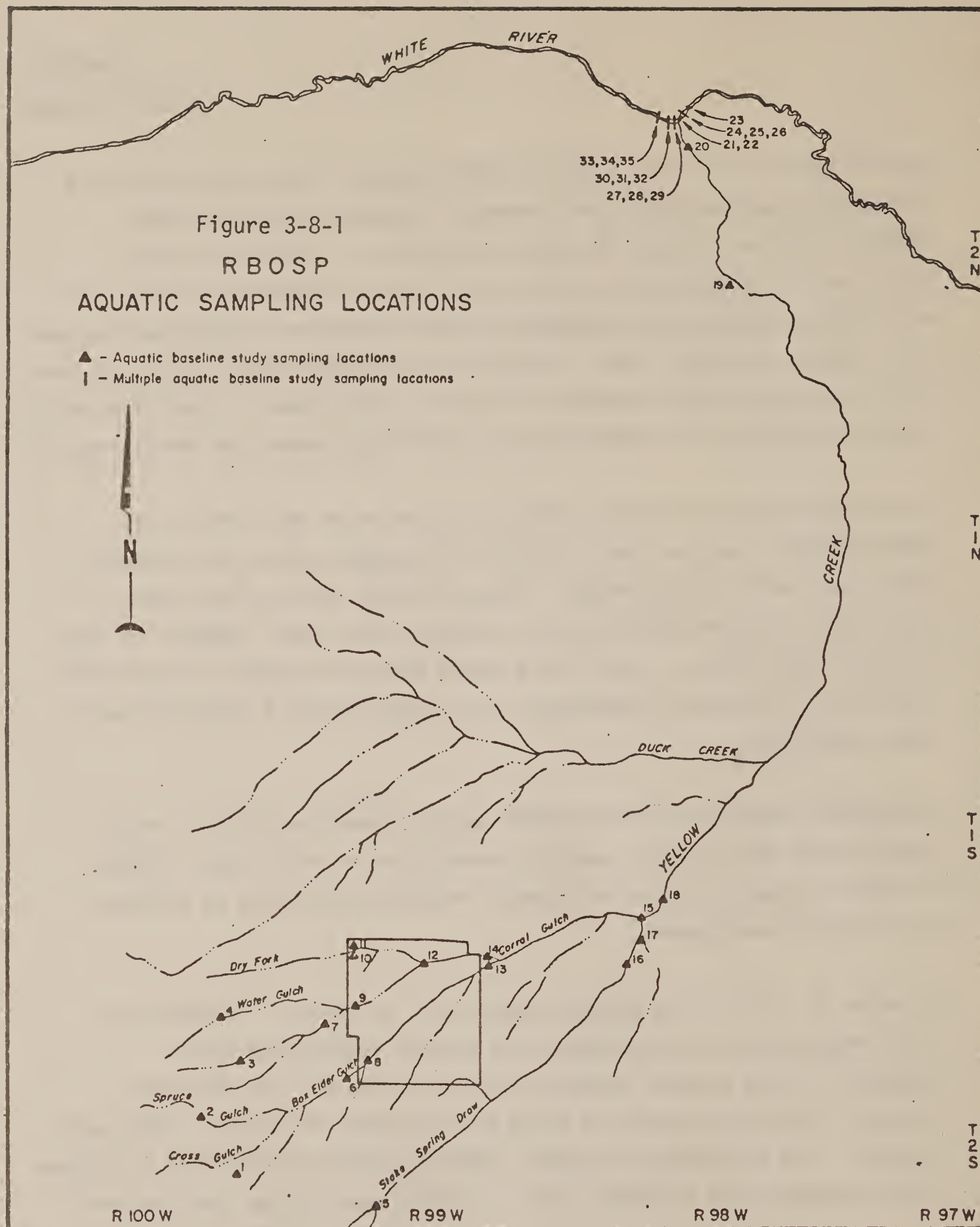


Table 3-8-1. Location of Sampling Stations

Station	Location
1	Cross Gulch Headwaters approximately 3200 meters (2 miles) above the confluence with Spruce Gulch. This is the lowest of the three springs in the area. This station is located at the highest elevation of all the stations. All of the seepages in the vicinity of this station have been tapped for use in livestock watering. Nearby aspen trees appear to contribute a substantial amount of organic matter in the form of dead leaves to the seepages.
2	Spruce Gulch Headwaters approximately 1500 meters (1 mile) above its confluence with Cross Gulch. This station is located approximately 50 meters downstream from the seepage area. The spring at the headwaters of Spruce Gulch appears to be a sulfur spring since the odor of H_2S is very evident and the bottom of the stream appears to be covered with an unidentified fungus.
3	Corral Gulch Headwaters approximately 50 meters from Maverick Spring.
4	Water Gulch Headwaters approximately 1500 meters (1 mile) above its confluence with Corral Gulch. This station is located about 50 meters below the seepage area.
5	Headwaters Area of Stake Springs Draw. This station is located in a marshy area approximately 8,000 meters (5 miles) above the confluence with Corral Gulch. This headwaters area consists of a series of seeps which form a marshy area with extensive aquatic vegetation.
6	The USGS gaging station on Box Elder Gulch, just after it enters Tract C-a.
7	The USGS gaging station on Corral Gulch near Water Gulch.
8	Box Elder Gulch (just after entering Tract C-a) approximately 1200 meters (0.8 mile) below the USGS gaging station. This station is located about 50 meters below the seepage area.
9	Corral Gulch approximately 200 meters below its confluence with Water Gulch. This station is located on a small swift stream which has a gravel substrate.
10	The USGS gaging station on Dry Fork just as it enters Tract C-a.

Table 3-8-1. Continued

Station	Location
11	Dry Fork just after entering Tract C-a. This station is located about 50 meters below the USGS gaging station on Dry Fork.
12	Corral Gulch just after its confluence with Dry Fork Gulch. This station is located about 50 meters below the confluence.
13	The USGS gaging station on Corral Gulch just as it leaves Tract C-a.
14	Corral Gulch just after leaving Tract C-a. This station is located at a pond approximately 1200 meters (0.8 mile) above 84 Ranch. Station 14 is located on a small pond which contains extensive mats of the aquatic plant <u>Zannichellia palustris</u> .
15	Corral Gulch approximately 100 meters upstream from its confluence with Stake Springs Draw.
16	The USGS gaging station on Stake Springs Draw.
17	Stake Springs Draw approximately 100 meters upstream of its confluence with Corral Gulch.
18	Yellow Creek approximately 100 meters downstream from the confluence of Corral Gulch and Stake Springs Draw.
19	Yellow Creek between the confluences of Duck Creek with Yellow Creek and Barcus Creek with Yellow Creek. This station is located at a pool which is choked with <u>Chara kieneri</u> .
20	Yellow Creek at the USGS gaging station near the White River.
21	Yellow Creek 100 meters above its confluence with the White River.
22	Yellow Creek 15 meters upstream from its confluence with the White River.
23	This station is located in a side channel of the White River about 800 meters (0.5 mile) above its confluence with Yellow Creek.

Table 3-8-1. Continued.

<u>Station</u>	
24,25,26	White River approximately 260 meters above the confluence of the White River with Yellow Creek. These stations are situated on a transect line which is perpendicular to the stream. Station 24 is located near the north shore of the White River; Station 25 is located in mid-stream; and Station 26 is located near the south shore.
27,28,29	These stations are located in the side channel at the confluence of the White River and Yellow Creek. Station 27 is situated about 30 meters above the confluence, Station 28 at the confluence, and Station 29 about 30 meters below the confluence.
30,31,32	These stations are located on the White River about 500 meters downstream from the confluence with Yellow Creek. Station 30 is located near the North shore of the White River; Station 31 is located in mid-stream; and Station 32 is located near the South shore.
33,34,35	These stations are located on the White River about 2500 meters (1.5 miles) downstream from the confluence with Yellow Creek. Station 33 is located near the North shore of the White River; Station 34 is located in mid-stream; and Station 35 is located near the South shore.

grouped as follows: headwater stations (1 - 5); tract stations (6 - 18); Yellow Creek (lower) stations (19 - 22); and White River stations (23 - 35).

The schedule for the RBOSP Aquatic Baseline Program is presented in Table 3-8-2. As indicated in Table 3-8-2, sampling efforts are intensified during periods of increased biological activity.

Tables 3-8-3 through 3-8-6 include sampling conditions for each station and sampling period during the one-year program discussed in this report.

At each sampling station, all physical, chemical and biological samples are taken on the same day.

Table 3-8-2. Schedule for RBOSP Aquatic Baseline Data Accumulation Program

RIO BLANCO OIL SHALE PROJECT	Month	1974			1975												1976											
		O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
Period of Performance					X	X		X			X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
Study Schedule																												
Field Studies																												
Physical		X			X			X	X	X	X	X	X	X	X					X	X	X	X					
Water Chemistry		X			X			X	X	X	X	X	X	X	X					X	X	X	X					
Plankton		X			X			X	X	X	X	X	X	X	X					X	X	X	X					
Periphyton		X			X			X	X	X	X	X	X	X	X					X	X	X	X					
Primary Productivity										X	X	X	X	X						X	X	X	X					
Analysis										X	X	X	X	X						X	X	X	X					
Benthos		X			X			X	X	X	X	X	X	X	X					X	X	X	X					
Macrophytes		X			X			X	X	X	X	X	X	X	X					X	X	X	X					
Fish		X			X			X	X	X	X	X	X	X	X					X	X	X	X					
Rare and Endangered Species		X			X			X	X	X	X	X	X	X	X					X	X	X	X					
Springs and Seepages		X			X	X		X	X	X	X	X	X	X	X					X	X	X	X					
Miscellaneous Studies								X		X		X		X	X					X								
Laboratory Analysis					X	X	X	X	X	X	X	X	X	X	X	X				X	X	X	X	X	X	X		
Statistical Analysis					X	X	X	X	X	X	X	X	X	X	X	X				X	X	X	X	X	X	X		

Table 3-8-3. Summary of flow conditions for Headwater Stations for RBOSP Aquatic Baseline Studies, October - November 1974 sampling period through August - September 1975 sampling period.

Station	Sampling Period					
	<u>October - November</u>	<u>December - January</u>	<u>April</u>	<u>May - June</u>	<u>July - August</u>	<u>August - September</u>
1	F	Inacc.	F	F	F	F
2	F	Inacc.	F	F	F	F
3	F	F	F	F	F	F
4	F	F	F	F	F	F
5	F	F	F	F	F	F

F = Flowing

Inacc. = Inaccessible

Table 3-8-6. Summary of flow conditions for White River Stations for RBOSP Aquatic Baseline Studies, October - November 1974 sampling period through August - September 1975 sampling period.

Station	Sampling Period					
	<u>October - November</u>	<u>December - January</u>	<u>April</u>	<u>May - June</u>	<u>July - August</u>	<u>August September</u>
Above Confluence with Yellow Creek						
23	F	F(IC)	F	F	F	F
24	F	F(IC)	F	F	F	F
25	F	F(IC)	F	F	F	F
26	F	F(IC)	F	F	F	F
27	F	F(IC)	F	F	F	F
At Confluence with Yellow Creek						
28	F	F(IC)	F	F	F	F
29	F	F(IC)	F	F	F	F
Below Confluence with Yellow Creek						
30	F	F(IC)	F	F	F	F
31	F	F(IC)	F	F	F	F
32	F	F(IC)	F	F	F	F
33	F	(IC)	F	F	F	F
34	F	F(IC)	F	F	F	F
35	F	F(IC)	F	F	F	F

F = Flowing
F(IC) = Flowing (Ice Covered)
IC = Ice Covered

8.1 ABIOTIC

A. Physical Measurements

1. Objectives - The objectives of this aspect of the Aquatic Baseline Studies are to determine certain physical characteristics of the streams at each sampling site and to relate these characteristics with selected chemical and biological characteristics. The physical measurement program also includes those chemical parameters which are measured in conjunction with field sampling operations.

2. Methods - The following methods were used to determine certain physical characteristics at each sampling site. These determinations were made concurrently with the collection of chemical and biological samples. Stream velocity was measured with a Gurley flowmeter at bank side and at the point of maximum flow at each station where possible. The stream substrate was visually classified at each station at the same time as benthic samples were collected. Color and odor were determined for each sample by methods described by the American Public Health Association (APHA, 1971). The turbidity of each sample was determined with a Hach Photometric Turbiditymeter. Field measurements of dissolved oxygen were taken with a Yellow Springs Instruments Inc. dissolved oxygen meter (Model 51A) or with the Alsterberg (Azide) modification of the Winkler Method (APHA, 1971).

In October - November 1974, field determinations of pH were taken with a Leeds and Northrup portable pH meter (Model No. 7417); during subsequent sampling periods pH determinations were made with an Analytical Measurements, Inc. portable meter (Model No. 107). Measurements of specific conductance were made with a Beckman RB-3 Solu-Bridge. Field measurements of water temperature were made with a Montedoro-Whitney Thermister (Model 7510LA) or equivalent. Depth measurements were taken with a calibrated steel range pole; width was measured with a steel tape measure. Colorimetric determinations of total alkalinity were made according to procedures described by the American Public Health Association (APHA, 1971).

3. Literature Review

a. Temperature - Temperature is a major factor in determining the biological make-up of streams. Water temperature influences the solubility of gases, the rates of chemical reactions, and the metabolic rates of stream organisms. Organisms respond to temperature according to their upper and lower thermal tolerance limits, optimum temperatures for growth, and temperature limits for migration, spawning, and egg incubation. Hynes (1970) noted that the temperature of streams is subject to large variations, depending upon such stream characteristics as depth, altitude, and distance from the source.

Until the present baseline studies were undertaken, virtually no data were available concerning water temperatures in streams on and near Tract C-a. However, limited data had been taken in the White River and in Yellow Creek.

During their investigations in 1968 - 1969, Everhart and May (1973) included two sampling locations on the White River near the present study area. Stations VII and VIII of Everhart and May were located on the White River above and below the confluence of Yellow Creek with the White River, respectively. (Station VII of Everhart and May was located near RBOSP aquatic Stations 24-26 and Station VIII was located near RBOSP aquatic Stations 30-32.) They also included one sampling location on Yellow Creek near Station 20 of the RBOSP aquatic studies. Water temperature data from the study of Everhart and May (1973) are presented in Table 3-8-7.

Between June and October, 1973, Pennak (1974) collected limnological data in Yellow Creek (near RBOSP aquatic Station 20) and in the White River above and below its confluence with Piceance Creek. Water temperature data from Pennak (1974) are presented in Table 3-8-8.

b. Specific Conductance - According to Hem (1959), specific conductance is a measure of the number of dissociated ions present in water. Therefore, as suggested by Brown et al. (1970), specific conductance provides, within rather wide limits, a measure of the ionic strength of the

Table 3-8-7. Summary of ranges of physical characteristics in Yellow Creek and the White River during 1968 and 1969 (taken from Everhart and May, 1973).

Characteristic	White River above Yellow Creek	White River below Yellow Creek	Yellow Creek
September-December 1968			
Temperature (°C)	0-11	0-12	0-19
Specific Conductance (µmhos/cm)	710-750	700-760	3400
Dissolved Oxygen (mg/l)	9.8-12.3	9.7-11.8	8.8-11.7
pH	8.2-8.4	8.0-8.4	8.3-8.7
Alkalinity (mg/l)	178-344	95-200	1544-1948
Turbidity (JTU)			
January-December 1969			
Temperature (°C)	0-22	0-24	0-31
Specific Conductance (µmhos/cm)	450-720	485-800	3000-3850
Dissolved Oxygen (mg/l)	5.2-12.0	5.6-11.8	6.8-12.0
pH	7.4-8.4	7.5-8.4	8.3-8.9
Alkalinity (mg/l)	120-210	70-240	912-1888
Turbidity (JTU)	<25-45	<25-105	<25-30

Table 3-8-8. Summary of ranges of physical characteristics in Yellow Creek and the White River during June - October 1973 (taken from Pennak, 1974).

Characteristic	White River above Yellow Creek	White River below Yellow Creek	Yellow Creek
Temperature ($^{\circ}\text{C}$)	7.8-14.8	8.5-15.3	2.5-13.0
pH	8.1- 8.2	8.0- 8.4	8.2- 8.5
Alkalinity (mg/l)	60-95	74-120	890-1060

solution. Hem (1959) reports that conductance in natural surface waters of the U.S. ranges from 50 to 50,000 micromhos/cm (the latter occurring in seawater). He also indicates that, while no exact relationship exists between conductance and dissolved solids in natural water, a generalized relationship may be defined as:

$$\text{Specific conductance (micromhos/cm at } 25^{\circ}\text{C)} \cdot A = \text{Dissolved solids (ppm)}$$

where the factor A has a value ranging from 0.5 to 1.0.

Table 3-8-7 summarizes the conductivity ranges observed in the White River and Yellow Creek by Everhart and May (1973). Weeks and Welder (1974) reported the results of analysis of water quality samples taken from Yellow Creek (near RBOSP aquatic Station 20) in May 1972 and August 1973. The specific conductance of Yellow Creek on those dates was 3,920 and 3,900 micromhos/cm, respectively.

c. Dissolved Oxygen - Dissolved oxygen (DO) is a critical component of aquatic ecosystems, since it is required by all aquatic life, except the anaerobic bacteria. In addition, it oxidizes the reduced and often noxious substances produced by the decay of organic materials.

According to Brown et al. (1970), the solubility of dissolved oxygen in water depends on the partial pressure of oxygen in the air, the temperature, and the mineral content of the water. In natural waters, dissolved oxygen is derived from atmospheric exchange and from photosynthesis by aquatic plants. Hynes (1970) notes that in small turbulent streams the oxygen content is usually near or above saturation, but that even in torrential streams the oxygen content varies seasonally from source to mouth. These variations are generally small and are biologically induced. In larger rivers, Hynes (1970) indicates that similar, although larger, variations are generally influenced by the amount of discharge, since greater quantities of organic material and higher turbidities occur during periods of higher discharge.

The Environmental Protection Agency (EPA)(1972) briefly reviewed the literature on the oxygen requirements of aquatic biota. As noted by the EPA, oxygen requirements are often different for different stages in the life cycle of aquatic organisms. Since fish eggs and/or larvae are relatively sensitive to lowered dissolved oxygen concentrations, recommended limits are generally based upon the maintenance of conditions suitable for the propagation and maintenance of sensitive fish populations. In the region of the White River included in the RBOSP Aquatic Baseline Study, the Colorado Department of Health (1974) requires that the dissolved oxygen concentration remain at 5 mg/l or higher.

Table 3-8-7 summarizes the dissolved oxygen ranges observed in the White River and Yellow Creek by Everhart and May (1973).

d. Alkalinity - Alkalinity is a measure of the ability of water to neutralize acids; it is expressed in terms of an equivalent amount of calcium carbonate (CaCO_3). Sawyer and McCarty (1967) indicated that alkalinity in natural waters is due primarily to the presence of the salts of weak acids. They also indicated that bicarbonates generally constitute the major form of alkalinity since large quantities of bicarbonates are formed from the action of carbon dioxide upon basic materials in the soil. Other salts of weak acids (i.e. borates, silicates, and phosphates) may contribute small amounts of alkalinity. Thus, alkalinity in natural waters generally provides a measure of the buffering capacity of the carbonate - bicarbonate system.

McKee and Wolf (1963) considered alkalinities greater than 100 mg/l optimal for biological productivity. The Federal Water Pollution Control Administration (FWPCA, 1968) indicated that, because of reduced buffering capacity, alkalinities of less than 20 mg/l may endanger the productivity of the water.

Table 3-8-7 summarizes the ranges of alkalinity found in the White River and Yellow Creek by Everhart and May (1973). Table 3-8-8 lists alkalinities observed in the White River and Yellow Creek by Pennak (1974). Pennak (1974) observed that the alkalinity concentrations which occurred in

Yellow Creek in 1973 were among the highest he had encountered anywhere. Weeks and Welder (1974) reported an alkalinity of 1,920 mg/l (as CaCO_3) in Yellow Creek in August 1973.

e. pH - According to Brown et al. (1970), the pH of water is a measure of the hydrogen-ion concentration, or more precisely, the hydrogen-ion activity. The EPA (1972) reported that most productive fresh waters have pH values which fall between 6.5 and 8.5. EPA (1972) also indicated that waters having a low pH and poor buffering capacity tend to be less productive. The Colorado Department of Health (1974) requires that a pH between 6.0 and 9.0 be maintained in the region of the White River which is included in RBOSP Aquatic Baseline Studies.

Table 3-8-7 lists the pH ranges observed by Everhart and May (1973) in Yellow Creek and the White River. Table 3-8-8 lists the pH values observed by Pennak (1974).

f. Color and Turbidity - The color of water is largely dependent upon the quantity and type of substances present in solution or in suspension. Turbidity, according to APHA (1971), is an expression of an optical property of the fine suspended matter in a water sample. Turbidity is therefore a measure of the opaqueness of the water caused by suspended matter. Together, color and turbidity affect the penetration of light to sub-surface plants and thus may depress the primary productivity of the water. High color and turbidity also reduce the aesthetic value of recreational waters.

Table 3-8-7 includes turbidities measured in the White River and Yellow Creek by Everhart and May (1973).

g. Stream Flow - The United States Geological Survey (USGS) has monitored the discharge of the White River near Meeker, Colorado, since 1909. The discharge data in Table 3-8-9 provide a general indication as to the large variability in discharge in the White River and to the seasons in which maximum and minimum discharge occur.

Table 3-8-9. Maximum and minimum discharge observed in the White River near Meeker, Colorado during 1968 - 1973. Data are derived from USGS (1970, 1971, 1972, 1973, 1974).

<u>Water Year</u>	<u>Maximum Mean Discharge</u>		<u>Minimum Mean Discharge</u>	
	<u>(Month)</u>	<u>(cfs)</u>	<u>(Month)</u>	<u>(cfs)</u>
1969	May	1959	February	315
1970	June	2283	February	338
1971	June	2171	February	345
1972	June	1738	August	322
1973	May	3660	January	300

4. Data Summary

a. Headwater Stations - Data concerning the physical characteristics of the aquatic sampling stations located near the headwater areas are summarized in Table 3-8-10. At the individual Headwater stations, water temperatures ranged from 1°C during October - November 1974 to 22°C during July - August. Specific conductance ranged from 825 micromhos/cm during May - June 1975 to 1,500 micromhos/cm during August - September 1975. Conductivities appeared generally lower at Station 1 than at the other Headwater stations. Highest conductivities were observed during December 1974 - January 1975 (Figure 3-8-2).

Dissolved oxygen (DO) concentrations at the Headwater stations ranged from 4.6 to 14.3 mg/l during the October - November 1974 and April 1975 sampling periods, respectively. DO concentrations were generally highest during December 1974 - January 1975 and lowest during July - August 1975.

Total alkalinities at individual stations ranged from 226 to 455 mg/l (as CaCO₃) during April 1974 and December 1974 - January 1975, respectively. Total alkalinities were generally lowest at the Headwater stations during May - June 1975 and highest during December 1974 - January 1975.

At the Headwater stations, pH ranged from 7.3 in August - September 1975 to 8.6 in April 1975. In general, lowest pH values were observed during July - August 1975 and August - September 1975; highest pH values occurred during May - June 1975.

Turbidities ranged from 1 to 85 JTU at individual stations. In general, the lowest turbidities were observed during December 1974 - January 1975 and the highest turbidities were found during April 1975 (Figure 3-8-3).

Color ranged from 0 - 5 to 30 - 40 APHA units. Minimum color was observed at the headwaters during October - November 1974 and December 1974 - January 1975; maximum color was observed during May - June 1975.

The substrate types at the Headwater stations varied from gravel at Station 2 to silt and detritus at Station 3.

Table 3-8-10. Summary of physical characteristics of streams at the Headwater Stations during RBOSP Aquatic Baseline studies, October - November 1974 sampling period through August - September 1975 sampling period.

Station	Characteristic				
	Water Temperature (°C)	Conductivity (µmhos/cm)	Dissolved Oxygen (mg/l)	Alkalinity Total (mg/l as CaCO ₃)	pH
October - November 1974					
1	1	875	10.6	356	8.0
2	7	1000	4.6	413	7.6
3	5	1190	8.5	345	7.9
4	8	1000	9.1	413	7.8
5	5	1400	11.8	410	8.2
December 1974 - January 1975*					
3	5	1300	9.9	455	7.6
4	5	1100	9.5	429	8.3
5	3	1300	10.2	422	8.2
*Stations 1 and 2 were inaccessible at the time of sampling.					
April 1975					
1	6	875	8.7	278	7.7
2	10	1200	7.5	372	8.0
3	5	850	8.8	226	8.2
4	11	1250	9.1	433	8.0
5	7	1450	14.3	415	8.6

Table 3-8-10. Continued.

Station	Characteristic				
	Water Temperature (°C)	Conductivity (μmhos/cm)	Dissolved Oxygen (mg/l)	Alkalinity Total (mg/l as CaCO ₃)	pH
May - June 1975					
1	8	825	8.5	265	8.0
2	9	1050	8.5	362	8.3
3	21	1250	6.6	382	8.5
4	21	1100	6.4	376	8.3
5	21	1450	10.0	353	8.3
July - August 1975					
		m			
1	19	900	7.1	393	7.7
2	11	1100	7.4	398	7.7
3	18	1200	6.7	383	7.8
4	17	1200	8.2	434	7.7
5	22	1400	7.3	388	8.3
August - September 1975					
1	12	950	6.1	409	7.3
2	11	1000	8.5	397	7.6
3	17	1300	6.0	442	7.9
4	11	1350	7.5	433	7.8
5	16	1500	9.4	416	8.2

3-8-22

Table 3-8-10. Continued

Station	Characteristic				
	Turbidity (JTU)	Color (APHA Units)	Substrate ¹	Width	Depth ²
					<u>s</u> <u>m</u> <u>s</u>
October - November 1974					
1	3	0-5	Gr	7"	2"
2	2	0-5	Gr	4"	2"
3	2	0-5	Si,D	2"	1"
4	5	0-5	Sa,Gr	1'4"	1 1/4"; 1 1/2"
5	2	0-5	Si,Cl	1'2"	4"
December 1974 - January 1975*					
3	1	0-5	Gr,D	13"	1/2"
4	2	0-5	Gr	8"	2"
5	1	0-5	Si,D	19'	3";4"
*Stations 1 and 2 were inaccessible at the time of sampling.					
April 1975					
1	1	10-20	Gr,Si	--	--
2	8	10-20	Gr	13"	1"
3	37	10-20	Gr	5"	1"
4	2	0-5	Gr,Sa	19"	1"
5	1	5-10	Gr,Si	40"	2";1"

¹Cl = Clay Gr = Gravel Si = Silt
D = Detritus Sa = Sand

²Measurements taken at each side (s) and in the middle (m) of the stream.

Table 3-8-10. Continued.

Station	Characteristic				
	Turbidity (JTU)	Color (APHA Units)	Substrate	Width	Depth
					s m s
May - June 1975					
1	1	5-10	Gr,Sa	24"	3"
2	2	10-20	Gr	48"	3"
3	19	10-20	Gr,Sa	10"	1"
4	87	30-40	Gr,Sa	27"	3"
5	2	20-30	Gr,Sa	20"	3"
July - August 1975					
1	83	10-20	Gr,Sa,D	12"	2½"
2	1	5-10	Gr,Sa	31"	2½"
3	7	10-20	Gr,Sa,Si	10"	½"
4	1	5-10	Gr,Sa	27"	2½"
5	3	20-30	Gr,Sa	10"	2"
August - September 1975					
1	12	10-20	Gr,Sa	6"	1"
2	3	10-20	Gr,Sa	12"	1"
3	85	20-30	Gr,Sa,D	8"	½"
4	6	10-20	Gr,Sa	28"	3"
5	1	10-20	Gr,Sa	9"	4"

3-8-24

3-8-25

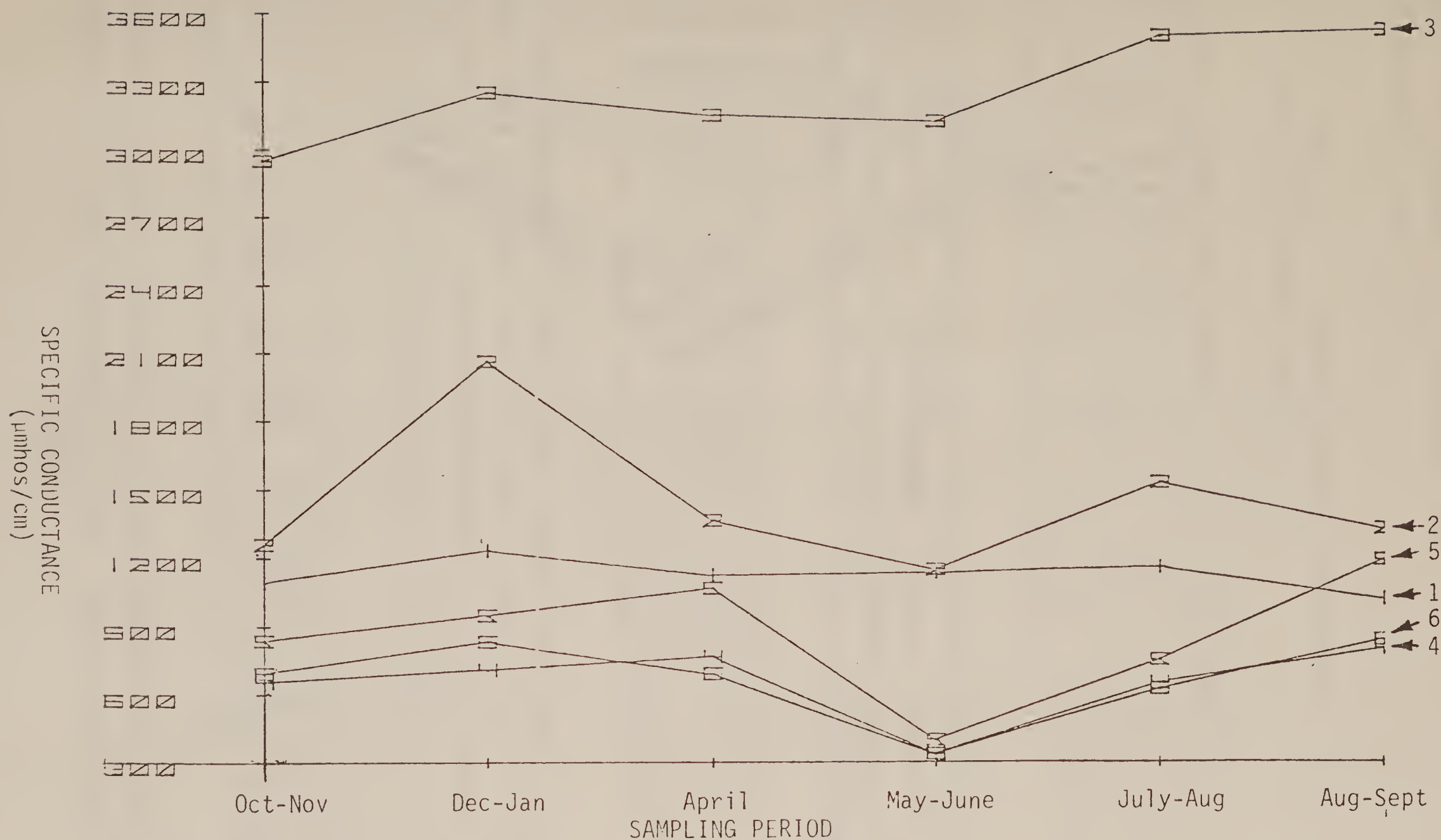


Figure 3-8-2. Mean specific conductance for station groups during RBOSP Aquatic Baseline Studies from October - November 1974 to August - September 1975. (Station Group 1 = Headwater; Group 2 = Tract; Group 3 = Yellow Creek; Group 4 = White River above confluence with Yellow Creek; Group 5 = White River at confluence with Yellow Creek; Group 6 = White River below confluence with Yellow Creek)

3-8-26

TURBIDITY
(JTU)

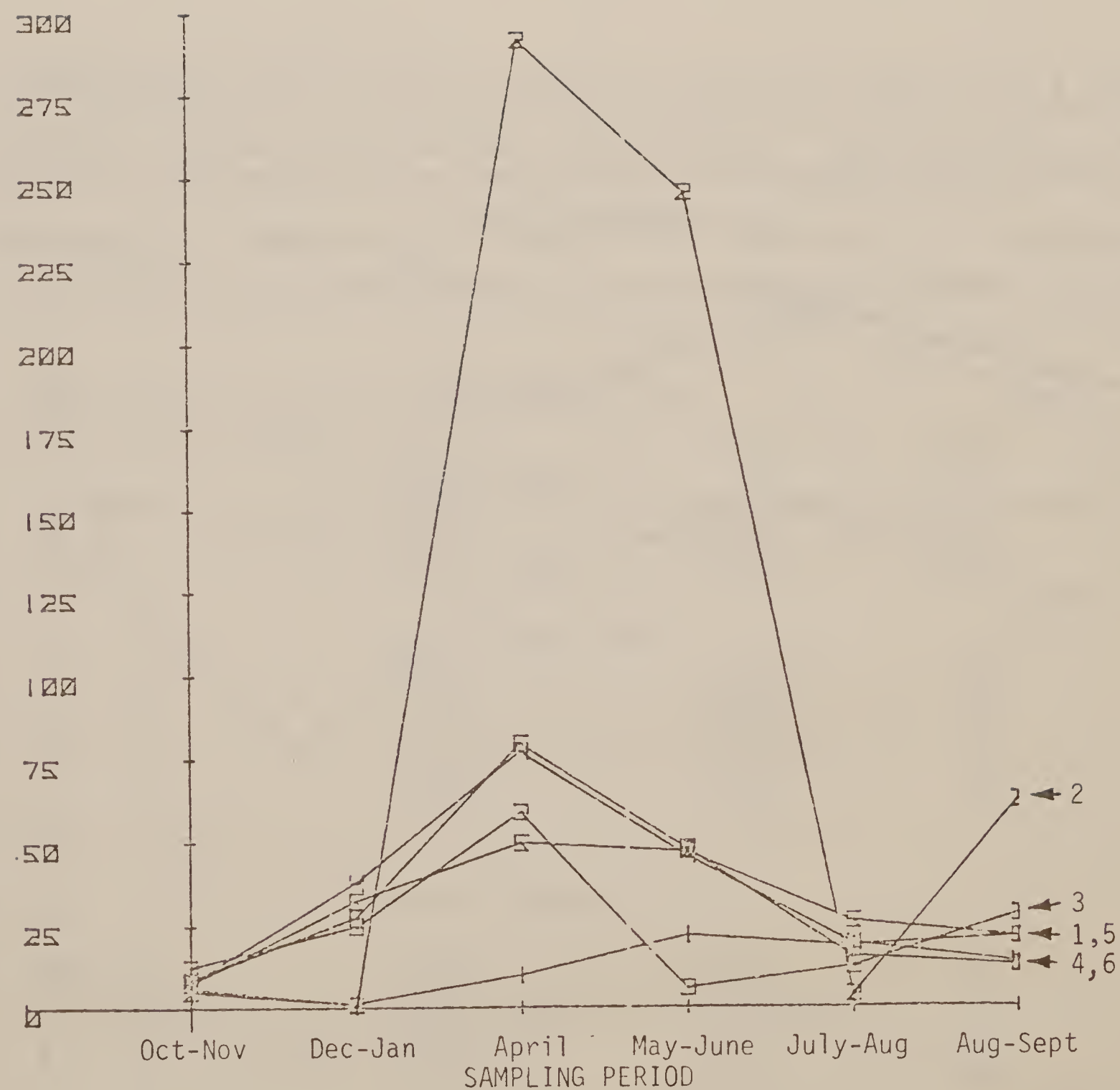


Figure 3-8-3. Mean turbidities for station groups during RBOSP Aquatic Baseline Studies from October - November 1974 to August - September 1975. (Station group 1 = Headwater; Group 2 = Tract; Group 3 = Yellow Creek; Group 4 = White River above confluence with Yellow Creek; Group 5 = White River at confluence with Yellow Creek; Group 6 = White River below confluence with Yellow Creek)

Minimum stream velocities at the Headwater stations were observed in December 1974 - January 1975 and maximum velocities were recorded during May - June 1975 (Table 3-8-11).

b. Tract C-a - A summary of physical measurements taken at the Tract stations is presented in Table 3-8-12.

Water temperatures at the individual stations ranged from 0°C to 27°C during the December 1974 - January 1975 and July - August 1975 sampling periods, respectively. Lowest water temperatures at the Tract stations were generally observed during December 1974 - January 1975; the highest water temperatures were observed during July - August 1975.

Specific conductance at the individual stations ranged from 800 to 4,250 micromhos/cm during May - June and December - January, respectively. The lowest overall conductivities occurred during October - November 1974 and the highest occurred during December 1974 - January 1975 (Figure 3-8-2).

Dissolved oxygen (DO) concentrations at the Tract stations ranged from 5.2 to 13.4 mg/l during April 1975 and October - November 1974, respectively. In general, the lowest DO concentrations occurred during July - August 1975 and the highest were observed during December 1974 - January 1975.

Total alkalinities at the Tract stations ranged from 274 mg/l (as CaCO₃) during October - November 1974 to 716 mg/l (as CaCO₃) in April 1975. The lowest overall alkalinities were observed during October - November 1974 and the highest alkalinities were found during April 1975.

At the Tract stations, pH values ranged from 7.4 during July - August 1975 to 8.6 during both October - November 1974 and April 1975. Generally, lowest pH values were found during July - August and August - September 1975. The highest pH measurements were observed during April 1975.

Turbidities at the Tract stations varied from 1 JTU (during several sampling periods) to 1,000 JTU during April 1975. Lowest turbidities generally

Table 3-8-11. Summary of stream velocities observed at Headwater Stations during RBOSP Aquatic Baseline Studies, October - November 1974 sampling period through August - September 1975 sampling period. (Results are expressed in feet per second, and where appropriate are given for bank side(s) and point of maximum velocity (m).)

Station	Sampling Period														
	October -			December -			April			May -			July -		
	November			January ¹						June			August		
	s	m	s	s	m	s	s	m	s	s	m	s	s	m	s
1		0.5						0.1(1/sec)		1.5			0.4		<0.1
2		1.4						0.8		2.5			1.3		0.9
3		0.5		0.3				0.4		0.9			1.3		1.3
4	0.9;		0.04	0.7				0.5		1.4			1.5		2.0
5		1.3		0.4				0.9;0.3		1.4			0.4		0.9

¹Stations 1, 2 were dry, frozen solid, or inaccessible due to snow accumulation at the time of sampling.

Table 3-8-12. Summary of physical characteristics of streams at the Tract Stations during RBOSP Aquatic Baseline Studies, October - November 1974 sampling period through August - September 1975 sampling period.

Station	Characteristic				
	Water Temperature (°C)	Conductivity (µmhos/cm)	Dissolved Oxygen (mg/l)	Alkalinity Total (mg/l as CaCO ₃)	pH

October - November 1974*

7	10	1000	9.6	274	8.6
8	9	1100	9.2	378	8.0
9	6	1200	9.5	383	7.6
13	10	1200	8.9	410	7.8
14	8	1800	13.4	454	8.2

*Stations 6, 10 - 12 and 15 - 18 were dry at the time of sampling.

December 1974 - January 1975*

8	5	1100	10.8	384	8.0
9	4	1200	8.9	405	7.9
13	7	4250	10.1	413	8.0
14	0	1700	11.2	521	7.8

*Stations 6, 7, 10-12 and 15-18 were dry, snow covered or frozen solid during the time of sampling.

Table 3-8-12. Continued.

Station	Characteristic				
	Water Temperature (°C)	Conductivity (μmhos/cm)	Dissolved Oxygen (mg/l)	Alkalinity Total (mg/l as CaCO ₃)	pH
April 1975*					
7	12	950	7.8	283	8.6
8	12	1100	10.5	375	8.4
9	10	1250	10.1	390	8.2
13	9	1730	5.2	716	8.3
14	5	1800	11.1	492	8.4
*Stations 6, 10 - 12 and 15 - 18 were dry at the time of sampling.					
May - June 1975*					
6	8	800	8.9	303	7.9
7	17	1100	7.5	346	8.2
8	9	850	7.9	325	7.9
9	20	1100	7.3	336	8.2
13	20	1500	5.6	646	8.3
14	18	1550	12.6	485	8.2
*Stations 10 - 12 and 15 - 18 were dry at the time of sampling.					

Table 3-8-12. Continued.

Station	Characteristic				
	Water Temperature (°C)	Conductivity (μmhos/cm)	Dissolved Oxygen (mg/l)	Alkalinity Total (mg/l as CaCO ₃)	pH
July - August 1975*					
7	22	1200	7.6	318	8.3
8	10	1050	7.7	370	7.4
9	23	1200	6.9	324	8.0
13	18	1200	6.2	396	7.5
14	19	2000	12.9	532	7.9
15	27	1900	8.0	461	8.0
17	18	1800	5.7	518	7.8
18	13	1900	7.9	514	8.1
*Stations 6, 10 - 12, 16 were dry at the time of sampling.					
August - September 1975*					
7	15	1200	8.2	385	8.0
8	11	1100	8.1	387	7.5
9	19	1200	7.9	364	8.0
12	17	1150	7.6	363	8.4
13	11	1300	7.6	419	7.6
14	12	1850	7.4	564	7.9
17	19	1500	7.9	526	7.8
*Stations 6, 10, 11, 15, 16, and 18 were dry at the time of sampling.					

Table 3-8-12. Continued.

Station	Characteristic				
	Turbidity (JTU)	Color (APHA Units)	Substrate ¹	Width	Depth ²
					s m s
October - November 1974*					
7	20	0-5	Sa,Gr	3'	3 " ; 1½"
8	2	0-5	Gr	10"	2 "
9	2	0-5	Gr	9"	2 "
13	2	0-5	Sa,Gr	3'	1 " ; 1 " ; 1½"
14	1	0-5	Cl	1'	6 "
*Stations 6, 10-12 and 15-18 were dry at the time of sampling.					
December 1974 - January 1975*					
8	1	0-5	Gr	13"	2 "
9	1	0-5	Gr,S	11"	2 "
13	1	0-5	Gr,S	3'	1½" ; 1½"
14	1	0-5	Gr,Veg	10"	2 "
*Stations 6, 7, 10 - 12 and 15 - 18 were dry, snow covered or frozen solid during sampling time.					

¹ Cl = Clay
 Gr = Gravel
 Sa = Sand
 Si = Silt
 Veg = Vegetation

² Measurements were taken at each side (s) and in the middle (m) of the stream.

Table 3-8-12. Continued.

Station	Characteristic				
	Turbidity (JTU)	Color (APHA Units)	Substrate	Width	Depth
April 1975*					s m s
7	445	10-20	Gr,Sa	10"	1"
8	2	0- 5	Gr,Sa	17"	1"
9	2	0- 5	Gr	11"	1"
13	1000	10-20	Gr,Si	36"	3"
14	9	5-10	Si	3"	2"
*Stations 6, 10-12 and 15-18 were dry at the time of sampling.					
May - June 1975*					
6	215	30-40	Gr,Sa	29"	8";4"
7	378	30-40	Gr,Sa	22"	2"
8	290	30-40	Gr	50"	5";2"
9	140	20-30	Gr,Si	24"	3"
13	450	20-30	Gr,Sa,Si	50"	4"
14	2	10-20	Sa,Cl	30'	36"
*Stations 10-12 and 15-18 were dry at the time of sampling.					

Table 3-8-12. Continued.

Station	Characteristic				
	Turbidity (JTU)	Color (APHA Units)	Substrate	Width	Depth
July - August 1975*					<u>s</u> <u>m</u> <u>s</u>
7	4	10-20	Gr,Si	9"	3 "
8	1	10-20	Gr,Si	51"	2½"; 2½"
9	4	10-20	Gr,Si	8"	3 "
13	6	10-20	Gr,Sa	34"	3 "
14	7	10-20	Sa,Si	43"	36 "
15	2	20-30	Gr,Sa	48"	2 "
17	8	10-20	Gr,Sa	12"	2 "
18	1	20-30	Gr,Sa	23"	2 "

*Stations 6, 10-12, and 16 were dry at the time of sampling.

August - September 1975*

7	30	10-20	Gr,Sa	14"	4 "
8	1	10-20	Gr,Sa	38"	2 "
9	40	10-20	Gr,Sa	27"	2 "
12	175	20-30	Gr,Sa	8"	½ "
13	1	10-20	Gr,Sa	30"	4 "
14	2	20-30	Si	28"	4 "
17	188	20-30	Gr,Sa	24"	½ "

*Stations 6, 10, 11, 15, 16, and 18 were dry at the time of sampling.

were observed during December 1974 - January 1975; highest turbidities occurred during April and May - June 1975 (Figure 3-8-3).

The substrate types at the Tract stations varied from silt at Station 14 to gravel at Stations 8 and 9.

Minimum stream velocities were recorded at Tract stations during December 1974 - January 1975 and maximum velocities were observed during May - June 1975 (Table 3-8-13).

c. Yellow Creek - Physical measurements taken at the Yellow Creek stations between October 1974 and September 1975 are summarized in Table 3-8-14.

Water temperatures at the individual Yellow Creek stations ranged from 0°C during December 1974 - January 1975 to 25°C during May - June and August - September 1975. The lowest overall water temperatures were observed during December 1974 - January 1975 whereas the highest temperatures were recorded during May - June and August - September 1975.

Specific conductance at the individual stations ranged from 1,900 micro-mhos/cm during May - June 1975 to 4,100 micromhos/cm during August - September 1975. In general, the lowest conductivities were observed during October - November 1974 whereas the highest conductivities were recorded during August - September 1975 (Figure 3-8-2).

Dissolved oxygen (DO) concentrations at the Yellow Creek stations varied from 7.2 mg/l during August - September 1975 to 14.3 mg/l during October - November 1974. Lowest overall DO concentrations were recorded during December 1974 - January 1975; the highest values were found during October - November 1974.

Total alkalinities at individual stations ranged from 650 mg/l (as CaCO_3) during July - August 1975 to 1,858 mg/l (as CaCO_3) during August - September 1975. The lowest alkalinities were generally observed during

Table 3-8-13. Summary of stream velocities observed at Tract Stations during RBOSP Aquatic Baseline Studies, October - November 1974 sampling period through August - September 1975 sampling period. (Results are expressed in feet per second, and where appropriate are given for bank side(s) and point of maximum velocity (m).)

Station	Sampling Period														
	October -			December -			April ³			May -			July -		
	November ¹			January ²						June ⁴			August ⁵		
	s	m	s	s	m	s	s	m	s	s	m	s	s	m	s
6										3.5;2.0					
7	1.0;		0.5				0.5			2.5			1.5		2.0
8		1.0			0.9		1.0			3.2;1.8			1.7;2.0		1.3
9		1.5			0.7		1.7			1.7			2.1		1.9
12															1.3
13	0.5;0.5;0.6			0.2;0.7;0.6			1.0			1.7			2.0		1.1
14		1.3			2.2		0.5			0.0			0.0		1.0
15													0.8		
17													0.4		0.0
18													0.8		

¹Stations 6, 10-12 and 15-18 were dry at the time of sampling.

²Stations 6, 7, 10-12, 15-18 were frozen solid or inaccessible at the time of sampling.

³Stations 6, 10-12 and 16 were dry at the time of sampling.

⁴Stations 10-12 and 15-18 were dry at the time of sampling.

⁵Stations 6, 10-12 and 16 were dry at the time of sampling.

⁶Stations 6, 10-11, 15-16 and 18 were dry at the time of sampling.

Table 3-8-14. Summary of physical characteristics of streams at the Yellow Creek Stations during RBOSP Aquatic Baseline Studies, October - November 1974 sampling period through August - September 1975 sampling period.

Station	Characteristic				
	Water Temperature (°C)	Conductivity (µmhos/cm)	Dissolved Oxygen (mg/l)	Alkalinity Total (mg/l as CaCO ₃)	pH
October - November 1974					
19	4	2800	14.3	772	8.2
20	7	3000	8.7	1149	8.5
21	8	3000	9.9	1244	8.6
22	10	3000	8.2	1264	8.6
December 1974 - January 1975					
19	2	2500	7.3	745	8.0
20	0	3500	8.4	1298	8.0
21	0	3500	7.9	1341	8.0
22	0	3500	7.9	1334	8.0
April 1975					
19	14	2700	11.4	707	8.6
20	14	3700	9.4	1291	8.6
21	14	3700	8.9	1306	8.6
22	10	3700	7.9	1302	8.5
May - June 1975					
19	15	1900	12.9	759	8.0
20	23	3600	8.2	1393	8.3
21	18	3400	9.2	1449	8.3
22	25	3600	10.5	1390	8.6

Table 3-8-14. Continued.

Station	Characteristic				
	Water Temperature (°C)	Conductivity (μmhos/cm)	Dissolved Oxygen (mg/l)	Alkalinity Total (mg/l as CaCO ₃)	pH
July - August 1975					
19	22	2600	8.1	650	8.4
20	19	3800	8.7	1375	8.8
21	19	3900	8.1	1451	8.7
22	16	3700	12.3	1445	8.7
August - September 1975					
19	16	2800	14.2	748	8.2
20	25	3300	7.2	1650	8.7
21	24	3900	8.8	1651	8.7
22	16	4100	8.2	1858	8.6

Table 3-8-14. Continued.

Station	Characteristic				
	Turbidity (JTU)	Color (APHA Units)	Substrate ¹	Width	Depth ²
					<u>s</u> <u>m</u> <u>s</u>
October - November 1974					
19	3	0-5	Si,St	10"	6"
20	12	0-5	Gr	2' 4"	4½"
21	25	0-5	Sa,Gr	5'10"	7";5";3"
22	10	0-5	Gr,Si	16'11"	2½";3";3½"
December 1974 - January 1975					
19	4	0-5	Gr,Sa,Si	26"	5";2"
20	35	0-5	Gr	24"	8"
21	30	0-5	I Cov	--	19"
22	30	0-5	Sa,Gr	--	8"
April 1975					
19	19	10-20	Gr,D	18"	6"
20	81	20-30	Gr,Si,Sa	12'	4";3"
21	68	5-10	Gr,Si	5' 5"	5";3"
22	69	10-20	Gr,Sa	6' 3"	4";8"
May - June 1975					
19	7	30-40	Gr	13"	9"
20	7	20-30	Gr,Sa	9'	4"
21	3	20-30	Gr,Sa	5'	4"
22	7	30-40	Sa,Si	30'	20"

¹ Cl - Clay, I Cov = Ice Covered, Gr - Gravel, Sa = Sand, Si = Silt, St = Stone

² Measurements taken at each side (s) and in the middle (m) of the stream.

Table 3-8-14. Continued.

Station	Characteristic				
	Turbidity	Color	Substrate	Width	Depth
	(JTU)	(APHA Units)			
	July - August 1975				<u>s</u> <u>m</u> <u>s</u>
19	9	30-40	Gr	10"	
20	7	20-30	Gr, Si	15"	
21	8	30-40	Gr, Sa	4' 6"	
22	25	25-35	Gr	35'	5"; 19"; 10"
August - September 1975					
19	23	30-40	Gr, Sa	9"	4"
20	28	25-35	Si, Gr, Sa	65"	3"
21	25	20-30	Gr, Sa	32"	4"
22	38	30-40	Gr, Sa	30"	4"

October - November 1974 and the highest alkalinities were recorded during August - September 1975.

At the Yellow Creek stations, pH values ranged from 8.0 during December 1974 - January 1975 and May - June 1975 to 8.7 during July - August and August - September 1975. In general, the lowest pH values were observed during December 1974 - January 1975 and the highest values were found during July - August 1975.

Turbidities at the Yellow Creek stations ranged from 3 JTU during October - November 1974 and May - June 1975 to 81 JTU during April 1975. Turbidities were lowest generally during October - November 1974 and highest during April 1975 (Figure 3-8-3).

The substrate of the Yellow Creek stations varied from silt and sand to gravel.

Minimum velocities were observed in Yellow Creek during October - November 1974 whereas maximum velocities were recorded during December 1974 - January 1975 (Table 3-8-15). Generally, velocities at Stations 20-22 did not vary appreciably during sampling periods.

d. White River - A summary of physical measurements taken at the White River stations between October 1974 and September 1975 is presented in Table 3-8-16.

Water temperatures at the White River stations ranged from 0°C during December 1974 - January 1975 to 21°C during July - August 1975. The lowest water temperatures generally were recorded during December 1974 - January 1975 whereas the highest temperatures were observed during July - August 1975.

Specific conductance at individual stations ranged from 250 micromhos/cm during May - June 1975 to 2,500 micromhos/cm during August - September 1975. In general, lowest conductivities were observed in the White River during May - June 1975 and highest conductivities were recorded during

Table 3-8-15. Summary of stream velocities observed at Yellow Creek Stations during RBOSP Aquatic Baseline Studies, October - November 1974 sampling period through August - September 1975 sampling period. (Results are expressed in feet per second, and where appropriate are given for bank sides (s) and point of maximum velocity (m).)

Station	Sampling Period																	
	October -			December -			April			May -			July -			August -		
	November			January						June			August			September		
	s	m	s	s	m	s	s	m	s	s	m	s	s	m	s	s	m	s
19		2.8		3.0;		1.0			2.4		1.8		1.8				1.2	
20		1.7				1.9	1.6;		1.0		1.3		1.4				0.7	
21	0.8;	1.4;	0.2			0.3	1.3;		1.7		0.8		0.8				1.2	
22	1.0;	0.8;	0.2			1.6	1.3;		0.4		0.7		0.7				1.5	

Table 3-8-16. Summary of physical characteristics of streams at the White River Stations during RBOSP Aquatic Baseline Studies, October - November 1974 sampling period through August - September 1975 sampling period.

Station	Characteristic				
	Water Temperature (°C)	Conductivity (µmhos/cm)	Dissolved Oxygen (mg/l)	Alkalinity Total (mg/l as CaCO ₃)	pH
October - November 1974					
Above Confluence with Yellow Creek					
23	2	750	11.9	190	8.0
24	12	600	11.4	182	8.2
25	12	650	11.4	180	8.2
26	12	650	11.4	198	8.2
27	11	650	12.1	199	8.6
At Confluence with Yellow Creek					
28	8	865	11.6	194	8.2
29	11	648	10.8	224	8.7
Below Confluence with Yellow Creek					
30	12	675	12.0	179	8.0
31	12	700	11.8	178	8.0
32	12	700	12.0	191	8.0
33	12	700	8.8	183	8.4
34	10	700	11.6	179	8.4
35	10	700	11.6	198	8.4

Table 3-8-16. Continued.

Station	Characteristic				
	Water Temperature (°C)	Conductivity (μmhos/cm)	Dissolved Oxygen (mg/l)	Alkalinity Total (mg/l as CaCO ₃)	pH
December 1974 - January 1975					
Above Confluence with Yellow Creek					
23	0	750	11.8	244	8.5
24	0	750	11.5	185	8.3
25	0	700	11.4	187	8.3
26	0	750	11.6	200	8.3
27	0	600	12.6	246	8.0
At Confluence with Yellow Creek					
28	0	900	12.8	247	8.2
29	0	1000	12.5	358	8.0
Below Confluence with Yellow Creek					
30	0	750	11.7	206	8.0
31	0	800	11.9	210	8.0
32	0	700	10.8	230	8.0
33	0	950	13.2	208	8.6
34	0	900	11.5	235	8.6
35	0	900	11.8	241	8.6

3-8-44

Table 3-8-16. Continued.

Station	Characteristic				
	Water Temperature (°C)	Conductivity (μmhos/cm)	Dissolved Oxygen (mg/l)	Alkalinity Total (mg/l as CaCO ₃)	pH
April 1975					
Above Confluence with Yellow Creek					
23	10	675	8.4	169	8.4
24	11	760	9.1	180	8.3
25	11	775	8.8	176	8.3
26	11	775	8.7	179	8.3
27	15	850	9.8	207	8.5
At Confluence with Yellow Creek					
28	13	*YC 1800	9.4	211	8.4
29	13	*WR 800-820	10.1	207	8.4
*YC = In Yellow Creek at confluence					
*WR = In White River at confluence					
Below Confluence with Yellow Creek					
30	12	770	8.5	179	8.4
31	12	720	8.6	174	8.4
32	12	770	8.8	200	8.4
33	14	630	9.1	173	8.2
34	14	630	8.8	169	8.2
35	14	630	8.7	170	8.2

3-8-45

Table 3-8-16. Continued.

Station	Characteristic				
	Water Temperature (°C)	Conductivity (μmhos/cm)	Dissolved Oxygen (mg/l)	Alkalinity Total (mg/l as CaCO ₃)	pH
May - June 1975					
Above Confluence with Yellow Creek					
23	12	450	9.0	117	7.9
24	13	300	8.7	118	7.8
25	13	300	8.3	123	7.9
26	13	300	8.2	115	7.9
27	12	350	8.9	109	8.0
At Confluence with Yellow Creek					
28	12	400	9.1	164	8.0
29	12	400	8.9	123	8.0
Below Confluence with Yellow Creek					
30	13	300	8.5	137	8.2
31	13	250	8.4	124	8.1
32	13	350	8.5	139	8.1
33	13	350	8.1	113	7.8
34	12	375	8.2	109	7.8
35	12	400	8.4	113	7.8

Table 3-8-16. Continued.

Station	Characteristic				
	Water Temperature (°C)	Conductivity (μmhos/cm)	Dissolved Oxygen (mg/l)	Alkalinity Total (mg/l as CaCO ₃)	pH
July - August 1975					
s m s					
Above Confluence with Yellow Creek					
23	19	675;675;650	8.5	185	8.1
24	21	625;625	8.3	397	8.2
25	21	700;750;650	7.9	455	8.2
26	21	625;625	7.8	462	8.2
27	18	625;625;625	8.5	473	8.2
At Confluence with Yellow Creek					
28	19	1250;700;675 675;675*	8.7	189	8.2
29	18	750;675;625	8.2	453	8.2
Below Confluence with Yellow Creek					
30	18	600;600	8.2	462	8.2
31	18	600;600	7.9	453	8.2
32	18	600;600	8.1	486	8.2
33	19	625;625;625	8.2	188	8.2
34	19	650;650;650	8.1	186	
35	19	620;625;650 650;650*	8.0	187	

*Cross-stream conductivity profile

Table 3-8-16. Continued.

Station	Characteristic				
	Water Temperature (°C)	Conductivity (μmhos/cm)	Dissolved Oxygen (mg/l)	Alkalinity Total (mg/l as CaCO ₃)	pH
August - September 1975					
		<u>s</u> <u>m</u> <u>s</u>			
Above Confluence with Yellow Creek					
23	15	850; 850; 850	9.3	230	8.3
24	17	775; 775; 775	10.3	211	8.2
25	17	775; 775; 775	10.1	218	8.2
26	17	800; 800; 775	10.3	209	8.2
27	18	825; 800; 800	10.9	206	8.6
At Confluence with Yellow Creek					
28	18	800; 1250; 2500	10.5	422	8.6
29	18	825; 900; 875	10.2	230	8.6
Below Confluence with Yellow Creek					
30	18	850; 825; 800	10.7	212	8.4
31	18	800; 800; 800	10.1	214	8.4
32	18	800; 800; 800	10.6	221	8.3
33	16	875; 875; 875	9.7	236	8.4
34	16	875; 875*	9.9	225	8.4
35	16	875; 875; 875	9.2	228	8.4

Table 3-8-16. Continued.

Station	Characteristic				
	Turbidity (JTU)	Color (APHA Units)	Substrate ¹	Width	Depth ² <u>s</u> <u>m</u> <u>s</u>
October - November 1974					
Above Confluence with Yellow Creek					
23	10	0-5	Co	28'	4";16"; 6"
24	8	0-5	Co,Sa	152'	2";22"; 9"
25	7	0-5	Co	152'	2";22"; 9"
26	8	0-5	Gr,Co	45'	2";19";14"
27	7	0-5	Co		
At Confluence with Yellow Creek					
28	7	0-5	Gr,Sa	65'	3"; 7"; 1"
29	8	0-5	Co,St	22'7"	1";12"; 2"
Below Confluence with Yellow Creek					
30	9	0-5	Co	138'	2";21";10"
31	10	0-5	Co	138'	2";21";10"
32	10	0-5	Co	138'	2";21";10"
33	8	0-5	Gr	26'10"	3";25";12"
34	9	0-5	Gr,Co	47' 2"	4";23"; 4"
35	8	0-5	Gr,Co	56'	4";23"; 3"

¹Co = Cobbles Gr = Gravel Sa = Sand St = Stone
 D = Detritus ND = Not Determined Si = Silt

²Measurements taken at each side (s) and in the middle (m) of the stream

Table 3-8-16. Continued.

		Characteristic			
	Turbidity (JTU)	Color (APHA Units)	Substrate	Width	Depth
					<u>s</u> <u>m</u> <u>s</u>
December 1974 - January 1975					
Above Confluence with Yellow Creek					
23	40	0-5	Co,Sa	35'	Ice, 18", 12"
24	40	0-5	Sa,Gr	150'	Ice, 18", 12"
25	40	0-5	Co	150'	Ice, 18", 12"
26	40	0-5	Co	150'	Ice, 18", 12"
27	30	0-5	Co		
At Confluence with Yellow Creek					
28	35	0-5	ND		
29	30	0-5	ND		
Below Confluence with Yellow Creek					
30	20	0-5	Co	113'	Ice, 18", 3"
31	20	0-5	Co	113'	Ice, 18", 3"
32	10	0-5	Co	113'	5"
33	10	0-5	Co,Gr	5'	5"
34	60	0-5	Co,Gr	5'	12", 22", 6"
35	45	0-5	Co,Gr	45'	

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Table 3-8-16. Continued.

Station	Characteristic				
	Turbidity (JTU)	Color (APHA Units)	Substrate	Width	Depth
April 1975					<u>s</u> <u>m</u> <u>s</u>
Above Confluence with Yellow Creek					
23	65	10-20	Co,Gr	31'	4";20"; 8"
24	90	20-30	Co,Gr	136'	3";10";24"
25	93	20-30	Co,Gr	136'	26";28";19"
26	95	10-30	Co,Gr	136'	16";13"; 2"
27	44	10-20	Gr,Si	46' 6"	2";23"; 4"
At Confluence with Yellow Creek					
28	47	10-20	Gr,Sa	74' 5"	1"; 8"; 1"
29	53	5-10	Gr,D	20'10"	1";11"; 1"
Below Confluence with Yellow Creek					
30	92	5-10	Co,Gr	150'	2";16";18"
31	89	20-30	Co,Gr	150'	18";20";14"
32	98	20-30	Co,Gr	150'	15";21"; 4"
33	70	20-30	Gr,Sa	41'	1";30"; 2"
34	70	10-20	Gr,Sa	44'	14";16"; 1"
35	66	10-30	Gr,Sa	58'	2";24"; 1"

Table 3-8-16. Continued.

Station	Characteristic				
	Turbidity (JTU)	Color (APHA Units)	Substrate	Width ¹	Depth
					<u>s</u> <u>m</u> <u>s</u>
May - June 1975					
Above Confluence with Yellow Creek					
23	44	30-40	Co	35'	36"
24	30	30-40	Co,Gr	ND	36";42"
25	45	30-40	Co,Gr	ND	48";34"
26	49	30-40	Co	ND	32";34"
27	64	30-40	Co	ND	36"
At Confluence with Yellow Creek					
28	47	20-30	Gr	ND	18";36"
29	48	20-30	Co	ND	20";20"
Below Confluence with Yellow Creek					
30	41	30-40	Co,Gr	ND	28";36"
31	41	30-40	Co,Gr	ND	34"
32	37	30-40	Co,Gr	ND	30";48"
33	63	30-40	Co	ND	36"
34	57	30-40	Co	ND	36";36";15"
35	52	20-30	Co	ND	27";36";56"

¹ND = Not Determined

Table 3-8-16. Continued.

Station	Characteristic				
	Turbidity (JTU)	Color (APHA Units)	Substrate	Width	Depth
July - August 1975					
Above Confluence with Yellow Creek					
					<u>s</u> <u>m</u> <u>s</u>
23	20	20-30	Gr	35'	6";19";10"
24	15	20-30	Co,Gr	139'	4";19";26"
25	20	15-25	Co	139'	34";26";14"
26	15	10-20	Co	139'	12";11";10"
27	28	10-20	Sa,Si	45'	8";28";18"
At Confluence with Yellow Creek					
28	28	15-25	Co,Sa	73'	7";13"; 1"
29	20	15-25	Co,Gr	35'	7";16"; 6"
Below Confluence with Yellow Creek					
30	18	10-20	Co	148'	6";18";20"
31	18	10-20	Co	148'	18";18";24"
32	20	10-20	Co	148'	27";27";12"
33	13	8-15	Gr,Si	45'	14";24";13"
34	10	10-20	Gr,Sa	39'	28"; 8";13"
35	15	10-20	Gr,Sa	58'	11";30"; 6"

Table 3-8-16. Continued.

Station	Characteristic				
	Turbidity (JTU)	Color (APHA Units)	Substrate	Width	Depth
August - September 1975					<u>s</u> <u>m</u> <u>s</u>
Above Confluence with Yellow Creek					
23	15	20-30	Co,Gr	33'	10";21"; 6"
24	15	20-30	Co,Sa	138'	4";21"; 6"
25	15	20-30	Co,Sa	138'	4"; 7";18"
26	13	20-30	Co,Sa	138'	18";23";20"
27	10	20-30	Co,Sa	45'	20";12"; 7"
At Confluence with Yellow Creek					
28	28	15-25	Co,Sa	66'	7";18"; 7"
29	15	10-20	Co,Sa	45'	7";12"; 7"
Below Confluence with Yellow Creek					
30	13	10-20	Co,Gr	146'	9";11";13"
31	13	10-20	Co,Gr	146'	13";17";20"
32	17	10-20	Co,Gr	146'	20";20"; 7"
33	10	10-20	Co,Si	45'	14";16"; 9"
34	15	20-30	Co,Sa	10'	13";20";
35	10	10-20	Co	58'	7";29";19"

May - June 1975 and highest conductivities were recorded during August - September 1975 (Figure 3-8-3). Conductivities were consistently highest at Stations 28 and 29 (at the confluence of the White River and Yellow Creek).

Dissolved oxygen (DO) concentrations at the White River stations varied from 7.8 mg/l during July - August 1975 to 13.2 mg/l during December 1974 - January 1975. DO concentrations were generally lowest during July - August 1975 and highest during December 1974 - January 1975.

Total alkalinities in the White River ranged from 109 mg/l (as CaCO_3) during May - June 1975 to 486 mg/l (as CaCO_3) during December 1974 - January 1975. In general, the lowest alkalinities were recorded during the May - June period whereas the highest alkalinities were found during July - August.

At the White River stations, pH values ranged from 7.8 during May - June 1975 to 8.7 during October - November 1974. The lowest overall pH values were recorded during May - June 1975 and the highest were observed during August - September.

Turbidities at the White River stations ranged from 98 JTU in April 1975 to 7 JTU during October - November 1974. The lowest turbidities at the White River stations generally were recorded during October - November 1974; the highest turbidities were observed during April 1975 (Figure 3-8-3).

The substrate of the White River in the study area varies from sand to silt to cobble.

Minimum velocities were observed in the White River during August - September 1975 and the maximum velocities were recorded during May - June (Table 3-8-17).

Table 3-8-17. Summary of stream velocities observed at White River Stations during RBOSP Aquatic Baseline Studies, October - November 1974 sampling period through August - September 1975 sampling period. (Results are expressed in feet per second, and where appropriate are given for bank sides (s) and point of maximum velocity (m).)

Station	Sampling Period																	
	October - November			December - January			April			May - June			July - August			August - September		
	s	m	s	s	m	s	s	m	s	s	m	s	s	m	s	s	m	s
	Above Confluence with Yellow Creek																	
23	2.9;3.3;1.4			1.4			1.2;3.5			2.1;0.2			1.0;2.9			1.0;1.9;0.1		
24	1.7;3.2;1.2			2.2; 3.2			1.7;2.0;3.8			4.4;3.0			2.4;2.2			0.9;1.6;2.6		
25	1.7;3.2;1.2			2.2; 3.2			3.8;3.6;3.0			7.5			2.8;2.9			2.6;3.3;2.7		
26	1.7;3.2;1.2			2.2; 3.2			3.0;2.8;2.5			4.6;3.0			1.9;2.9			2.7;2.3;1.0		
27	0.4;0.4;0.6			ND			0.4;1.2			1.6;1.2			0.4;1.2			0.1;0.9;0.3		
At Confluence with Yellow Creek																		
28	1.0;1.4;0.5			ND			1.9;1.9			3.3;0.8			1.0;1.3			0.2;1.2;1.0		
29	3.4;2.3			1.3;3.6;2.3			1.9;3.6			5.8;3.1			2.1;3.1			2.3;2.5;1.3		
Below Confluence with Yellow Creek																		
30	0.8;2.8;1.9			1.3;3.6;2.3			1.3;2.2;2.2			5.3			2.7;3.1			1.2;2.5;1.3		
31	0.8;2.8;1.9			1.3;3.6;2.3			2.3;2.5;2.4			6.7			2.4;3.1			2.3;2.3;2.7		
32	0.8;2.8;1.9			1.3;3.6;2.3			2.4;2.0;1.0			3.9;1.5			1.7;2.9			2.7;2.3;0.6		
33	0.3;1.4;1.0			0.5			1.4;2.5			3.5			1.0;2.8			0.5;0.5;0.3		
34	2.7;3.0;2.0			0.5			3.5;2.5			3.5			1.0;1.7			1.4;3.6		
35	3.4;4.3;2.5			2.3;2.9;2.7			4.6;2.7			4.0;3.1			1.7;2.9			1.7;5.2;2.6		

ND = Not Determined

5. Discussion - The aquatic habitats observed during the initial year of RBOSP Aquatic Baseline Studies included small, shallow springs of less than one ft (0.3 m) in width and less than one inch (2.4 cm) in depth; small, shallow ponds; and the major stream in the area, the White River which, at times, exceeds 150 ft (45 m) in width and four ft (1.2 m) in depth.

Water temperatures in the study areas ranged from 0 to 27°C. During the winter, temperatures at the headwaters remained higher than those in the other streams, probably because the headwaters are spring fed. Yellow Creek appeared to warm most rapidly in the spring and maintained the highest temperatures between June and August 1975. Water temperatures in the White River were above 20°C during the July - August sampling. It has been noted (Pennak, 1974) that streams in the Piceance Basin generally had higher mid-summer temperatures than other Rocky Mountain streams due to the relatively low elevations of the Piceance Basin. This appears to be the case in the Tract C-a study area.

DO concentrations varied seasonally, particularly in the small springs and streams on and near Tract C-a. Hynes (1970) indicates that such variations may be biologically induced. In the study area, dissolved oxygen (DO) concentrations ranged from 4.6 mg/l at Station 2 in October - November 1974 (the smell of sulfur near that site during the October - November sampling suggested the inflow from sulfur springs) to 14.3 mg/l at Station 5 in April 1975. In Yellow Creek, the highest DO concentration was recorded in October 1974, and the lowest in December 1974 - January 1975. Previous investigators (Everhart and May, 1973) reported low DO concentrations during November and December. The occurrence of low DO in the winter months probably indicates the death and decay of filamentous algae in Yellow Creek due to the advent of ice cover and the decreased light intensity under the ice cover. In the White River, on the other hand, highest DO concentrations occurred in December 1974 - January 1975 and the lowest concentrations were recorded during July - August 1975. Because of the relatively large size, swift currents and great turbulence of the White River, seasonal variations

in its DO concentrations are probably more closely related to water temperature than to changes caused by biological activity.

The streams in the study area are very alkaline, as indicated by the ranges of total alkalinity (113 to 1,858 mg/l) and pH (7.3 to 8.7). Yellow Creek (particularly Stations 20 - 22) had the highest alkalinities of any of the streams studied. Alkalinities in Yellow Creek consistently exceeded 109 to 486 mg/l. Seasonal variations in alkalinity were particularly evident in the White River, where lowest alkalinities were recorded during May - June 1975 sampling (a period of very high flows) and highest alkalinities were observed during the July - August 1975 sampling. The range of alkalinities observed in the White River during the initial year of RBOSP Aquatic Baseline Studies was somewhat greater than those observed by previous investigators (Everhart and May, 1973; Pennak, 1974); the range in Yellow Creek was somewhat less. Certainly, all of the streams considered in the RBOSP aquatic studies contain alkalinities well in excess of the 20 mg/l suggested as necessary for biologically productive waters by FWPCA (1968).

Specific conductance was very high in Yellow Creek, particularly at Stations 20 - 22, and was lowest in the White River. In general, lowest conductivities were recorded during periods of high flow and the highest conductivities during periods of low flow. Pennak (1974) suggested that the high concentrations of dissolved materials in streams of the Piceance Basin is related to the relatively soluble substrates which occur there.

Turbidities of streams included in the RBOSP Aquatic Baseline Studies were generally highest in the spring and lowest in the late fall and early winter. Local events, such as the movement of vehicles and animals through the streams, variations in groundwater flow and rain showers, often created high turbidities of short duration. The generally high turbidity of streams in the Piceance Basin has been related to the high alkalinities and relatively high clay content of the streamside soils of the basin (Pennak, 1974).

In summary, aquatic habitats considered in RBOSP Aquatic Baseline Studies program included small shallow springs and streams, small ponds and the relatively large and turbulent White River. Water temperatures were generally high during the summer and dissolved oxygen concentrations fluctuated seasonally and among sampling stations. Variations in DO concentrations in the small springs and streams and in Yellow Creek probably reflected variations in biological activity, whereas seasonal variations in the DO of the White River were probably more closely related to variations in water temperature. Due to the relatively soluble alkaline substrates of the region, waters were very alkaline and had high conductivities. Turbidities varied with local conditions but were generally highest during the spring and lowest during late fall and early winter.

B. Chemical Measurements

1. Objectives - The objectives of this aspect of the Aquatic Baseline Studies are to make determinations of certain chemical characteristics which may be of particular biological significance to the streams and to relate these chemical data to physical and biological data collected at the same time.

2. Methods - Duplicate samples were collected at each sampling station. Chemical determinations included: ammonia nitrogen, dissolved calcium, dissolved chloride, total hardness, dissolved magnesium, Kjeldahl nitrogen, dissolved nitrate, dissolved nitrite, dissolved orthophosphate, total phosphate, dissolved potassium, dissolved silica, dissolved sodium, dissolved sulfate, dissolved organic carbon, total organic carbon, suspended solids, and total dissolved solids. Other chemical measurements, made in conjunction with field sampling programs, are discussed in Section 8.1A.

Table 3-8-18 presents the analytical methods, limits of detection, and methods of sample preservation for the aforementioned analyses. The analytical methods for water listed in Table 3-8-18 are essentially those listed in the Federal Register, Volume 38, Number 199, October 16, 1973.

3. Literature Review - The chemical characteristics of streams directly reflect the local geography and climate. The climate of the region in which Tract C-a is located may be classified as semi-arid. According to USDI (1973), annual average precipitation varies from 10 to 18 in., depending on altitude. Approximately one-half of the precipitation occurs as snow. The USDA also indicated that local thunderstorms often bring large amounts of precipitation and local flash flooding to the area.

Streams near the tract drain a variety of soil units, which vary from deep loam to rough broken land with shallow soils above parent materials of silty shales or fine lime sandstones.

Table 3-8-18. Water and sediment chemistry, analytical laboratory methodology for RBOSP Aquatic Baseline Studies.

<u>Parameter</u>	<u>Measurement Methodology²</u>	<u>Detection Limit (ppm)³</u>	<u>Sample Preservation</u>
<u>WATER CHEMISTRY</u>			
Alkalinity, total ¹	Colorimetric	2	None required
Ammonia nitrogen	Electrode	0.10	HgCl ₂ + Refrigeration
Calcium, dissolved	Atomic absorption	0.02	HCl
Chloride, dissolved	Potentiometric	0.4	None required
Hardness, total	EDTA Titration	2	HCl
Magnesium, dissolved	Atomic absorption	0.005	HCl
Nitrogen, total Kjeldahl	Kjeldahl digestion - electrode	0.10	HgCl ₂ + Refrigeration
Nitrate, dissolved	Brucine	0.2	HgCl ₂ + Refrigeration
Nitrite, dissolved	Diazotization	0.01	HgCl ₂ + Refrigeration
Phosphate, ortho (dissolved)	Ammonium molybdate - potassium antimonyl tartrate	0.01	HgCl ₂ + Refrigeration
Phosphate, total	Same as orthophosphate	0.01	HgCl ₂ + Refrigeration
Potassium, dissolved	Atomic absorption	0.1	HCl
Silica, dissolved	Molybdosilicate	0.04	None
Sodium, dissolved	Atomic absorption	0.005	HCl
Sulfate, dissolved	Gravimetric	3	HCl
Carbon, dissolved organic	Beckman TOC Analyzer	2	Refrigeration
Carbon, total organic	Beckman TOC Analyzer	2	Refrigeration
Solids, suspended	Filtration	1	Refrigeration
Solids, total dissolved	Filtration and evaporation	1	Refrigeration

¹Field

²Methods are those specified in the Federal Register, Vol. 38, No. 199, Oct. 16, 1973, except for use of specific ion electrode.

³For water samples, this detection limit is the minimum concentration which will be reported on natural and treated water samples (99.99% H₂O) with the indicated method and using a sample of defined size.

Table 3-8-18. (Continued)

<u>Parameter</u>	<u>Measurement Methodology</u>	<u>Detection Limit (ppm)</u> ⁵	<u>Sample Preservation</u>
<u>SEDIMENT CHEMISTRY</u> ⁴			
Arsenic	Extraction and Colorimetric	1	Refrigeration
Aluminum	Extraction and Atomic absorption	10	Refrigeration
Herbicide	Gas Chromatography	100 ppb	Refrigeration
Lead	Extraction and Atomic absorption	5	Refrigeration
Mercury	Extraction and Atomic absorption	0.02	Refrigeration
Nitrogen, total Kjeldahl	Kjeldahl digestion - Electrode	25	Refrigeration
Phosphate, total	Persulfate digestion	3	Refrigeration
Solids, total volatile	Filtration, evaporation, volatilization	10	Refrigeration
Zinc	Extraction and Atomic absorption	2	Refrigeration

⁴Methods used are essentially those in the "Chemistry Laboratory Manual, Bottom Sediments" compiled by Great Lakes Region, Committee on Analytical Methods, EPA, 1969.

⁵Detection limits vary with sample size.

Land on and near Tract C-a is used for grazing by about 1,200 head of cattle during about five months of the year (USDI, 1973). Thus streams draining the area are subject to organic enrichment from animal wastes. The White River drains crop and pastureland and thus receives irrigation return flows as well as nutrient enrichment from grazing animals and nearby ranches and farms.

Since much of the water in these streams comes from groundwater rather than directly from rainfall, the composition of the aquifers through which the groundwater flows is undoubtedly a major factor in determining the amounts and types of ions occurring in the streams. In the vicinity of Tract C-a, the USGS (1974) reported the existence of two aquifers, designated as the upper and lower aquifers. As indicated in Section 3, Chapter 4, Hydrology, the total dissolved solids content of upper and lower aquifer water averaged at 1,290 and 3,940 mg/l, respectively during 1975.

a. Calcium - Calcium is often the most abundant cation in surface waters (Hem, 1959). It is an important component of silicate materials as well as limestone. Brown et al. (1970) reported that greater quantities of calcium are found in waters leaching deposits of limestone, dolomite, gypsum or gypsiferous shale. Brown et al. (1970) also reported that waters from limestone areas contain 30 to 100 mg/l of calcium, whereas waters which flow over gypsiferous shale may contain several hundred mg/l. Calcium is important as a macro-nutrient in plants (Eyster, 1974). However, as noted by Hynes (1970), the major role of calcium in aquatic ecosystems is in the bicarbonate buffering system found in most running waters.

Table 3-8-19 shows the ranges of calcium concentrations observed in the White River and Yellow Creek between 1969 and 1973 by various investigators.

b. Chloride - Hem (1959) reported that chlorides occur in all natural waters and that, in most surface streams, the chloride concentration is lower than the sulfate or bicarbonate concentrations. Brown et al. (1970) indicated that the chloride concentration in natural waters varies from less

than 1 mg/l to thousands of mg/l in brines. In small quantities, chlorides are essential to aquatic life; in large quantities they may upset the osmotic balance of the aquatic biota and thus may encourage the development of more tolerant brackish-water species adapted to high salinities. Hart et al. (1945, cited in McKee and Wolf, 1963) suggest that freshwater fish do well at concentrations below 170 mg/l.

Table 3-8-19 presents the ranges of chloride concentrations observed in Yellow Creek and the White River between 1969 and 1973.

c. Carbon Compounds - As noted by Hynes (1970), all natural surface waters carry dissolved and particulate organic matter, often in significant quantities. However, the fate and significance of these organic materials is poorly understood. The amount of organic material may serve as an indication of the quality and biological productivity of a water, depending upon whether the major source of organic materials is allochthonous or autochthonous. Pennak (1974) noted that, in general, streams in the Piceance Creek Basin carry larger quantities of suspended organic matter than those along the front range mountains.

d. Hardness - Hardness is a measure of the concentration of divalent metallic cations (primarily calcium and magnesium) and its concentration reflects the geological characteristics of the watershed (FWPCA, 1968). EPA (1972) indicated that hardness in water is a component of total dissolved solids and that the biological productivity of a water body is generally indirectly related to hardness. EPA (1972) also noted that in hard waters, the high concentrations of calcium and magnesium ions tend to reduce the toxicity of many metals to aquatic biota. Sawyer and McCarty (1967) presented the following classification of waters based upon degree of hardness: soft: 0 - 75 mg/l as CaCO_3 ; moderately hard: 75 - 150 mg/l as CaCO_3 ; hard: 150 - 300 mg/l as CaCO_3 ; and very hard: above 300 mg/l as CaCO_3 .

c. Magnesium - Magnesium is one of the ions generally responsible for hardness in natural waters. Hem (1959) reported that magnesium is an

Table 3-8-19. Summary of water chemistry data from studies of the White River and Yellow Creek (taken from Everhart and May (1973), Pennak (1974), and Weeks and Welder (1974). Data are expressed in mg/l unless otherwise noted.

Everhart and May (1973)			
	<u>White River above Yellow Creek</u>	<u>White River below Yellow Creek</u>	<u>Yellow Creek</u>
Calcium (Ca)	40.8 - 80.4	36.4 - 90.1	15.7 - 42.3
Magnesium (Mg)	9.6 - 26.4	9.7 - 28.9	43.2 - 145.0
Sodium (Na)	5.0 - 118.2	3.9 - 101.4	303.0 - 3,711.0
Potassium (K)	0.5 - 4.9	0.6 - 5.3	1.4 - 10.4
Chloride (Cl)	4.8 - 22.0	5.3 - 25.0	75.9 - 174.3
Sulfate (SO ₄)	52.9 - 188.0	54.6 - 186.8	405.9 - 892.0
Silica (SiO ₂)	12.0 - 27.0	13.0 - 23.5	3.2 - 23.0
Nitrate (NO ₃)	0.1 - 1.6	0.2 - 6.7	0.5 - 3.6
Filterable solids	193.0 - 475.0	209.0 - 572.0	2,312.0 - 3,178.0
Nonfilterable solids	12.0 - 1,117.0	10.0 - 3,989.0	48.0 - 1,644.0

Pennak (1974)			
	<u>White River above Yellow Creek</u>	<u>White River below Yellow Creek</u>	<u>Yellow Creek</u>
Calcium (Ca)	28.0 - 60.0	36.0 - 400.0	1,640.0 - 3,100.0
Sodium (Na)	0.8 - 30.1	21.7 - 31.2	632.8 - 914.5
Chloride (Cl)	20.0 - 33.0	17.5 - 35.0	145.0 - 190.0
Sulfate (SO ₄)	59.0 - 170.0	78.0 - 245.0	750.0 - 1,100.0
Dissolved inorganic matter	149.9 - 294.7	195.3 - 404.9	2,352.5 - 2,700.5
Suspended inorganic matter	9.3 - 61.7	18.2 - 68.2	7.2 - 43.0

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Table 3-8-19. (Continued)

Weeks and Welder (1974)	
	<u>Yellow Creek</u>
Calcium (Ca)	10.0
Magnesium (Mg)	120.0
Sodium (Na)	1,000.0
Potassium (K)	4.6
Chloride (Cl)	180.0
Sulfate (SO ₄)	590.0
Silica (SiO ₂)	2.9
Nitrate (N)	0.01
Dissolved solids (sum of constituents)	3,070.0

important component of igneous and limestone rock and that magnesium normally occurs in water in its ionic form. Magnesium is important as a plant macronutrient because it serves as a necessary constituent of chlorophyll. Brown et al. (1970) report that water associated with granite and siliceous sand may contain less than 5 mg/l of magnesium, but that water from dolomite or limestone rich in magnesium may contain 10 to 50 mg/l.

Table 3-8-19 presents the ranges of magnesium concentrations observed in Yellow Creek and the White River by Everhart and May (1973) and Weeks and Welder (1974).

f. Nitrogen Compounds - Because of its primary role in the synthesis of protein, nitrogen is an essential component of aquatic ecosystems. Since nitrogen occurs naturally in several valence states and undergoes both biological and non-biological transformations from one state to another, several forms of nitrogen are important in aquatic systems. The RBOSP Aquatic Baseline Studies examine the following forms of nitrogen: ammonia (NH_3 or NH_4^+), nitrate (NO_3^-), nitrite (NO_2^-) and Kjeldahl nitrogen (organic nitrogen + ammonia nitrogen).

Hutchinson (1957) reports that the major sources of nitrogen entering fresh water are atmospheric, domestic sewage effluents, animal and plant processing wastes, animal manure, fertilizer and chemical manufacturing spillage, various types of industrial effluents and agricultural runoff. Hynes (1970) suggests that rainfall and the land surface are the two major sources of nitrate in streams. Nitrate, according to Brown et al. (1970) is usually the most prevalent form of nitrogen in water and is an oxidation product of the decomposition of organic nitrogen. Hynes (1970) indicates that nitrate is generally the most prevalent form of nitrogen in fresh water. Hynes (1970) also suggests that nitrate has never been documented as a factor limiting plant growth in streams. He notes that normally the concentration of nitrates in a stream is low because the ions are rapidly assimilated by plants, but that such nutrients are probably quickly recycled in the stream.

Sawyer and McCarty (1967) report that waters which have been freshly polluted by organic matter contain relatively large concentrations of organic nitrogen and ammonia, which in turn is oxidized (under aerobic conditions) to nitrites and nitrates. Thus, waters containing large quantities of organic nitrogen and ammonia may have been more recently contaminated than those containing large quantities of nitrate. The form of nitrogen most easily utilized by most green plants is nitrate (Odum, 1971). Hutchinson (1957) indicates that certain green algae and diatoms prefer nitrate while others prefer ammonia as a source of nitrogen.

Table 3-8-19 presents data for nitrate concentrations observed in the White River and Yellow Creek by Everhard and May (1973) and Weeks and Welder (1974).

g. Phosphorus Compounds - Like nitrogen, phosphorus is an essential element for aquatic life and, also like nitrogen, phosphorus is cyclic and is continually changed in form by decomposition and synthesis processes. Phosphorus occurs as both simple ionic orthophosphate and as bound phosphate in soluble and particulate form (Hynes, 1970). Hutchinson (1957) reports that the major sources of phosphorus in fresh water are domestic sewage effluents, animal and plant processing wastes, fertilizer and chemical manufacturing spillage, various industrial effluents and, to a limited extent, erosion materials in agricultural runoff. Although phosphorus occurs as phosphate in many common minerals, Brown et al. (1970) report that its concentration in water is limited by the low solubility of phosphates of the alkaline earths. Brown et al. (1970) also indicate that the most common ionized form of phosphorous in water is orthophosphate and that it is the only ionized form derived from natural sources.

Soluble orthophosphate is the form of phosphorus most immediately available for uptake by plants (Prescott, 1968). Round (1965) contends that evidence also exists for the utilization of organic phosphorus by certain algae.

Stumm and Morgan (1970) indicate that the determination of total phosphorus is most likely of greater importance in assessing the nutrient loading of a system than is the determination of dissolved phosphorus. The FWPCA (1968) emphasizes that total phosphate serves as a reservoir of available phosphorus.

h. Potassium - Hem (1959) reports that most natural waters contain considerably less potassium than sodium, since sodium in most rocks is in a form which is more easily dissolved than is potassium. Hem (1959) also reports that concentrations of potassium seldom exceed 15 mg/l in ordinary surface and ground waters. Hutchinson (1957) indicates that, although small amounts of potassium are essential to plant and animal growth, high concentrations can be toxic. McKee and Wolf (1963) cite toxicity thresholds of 50 to 300 mg/l for potassium. Hynes (1970) notes that potassium is present in considerable quantities in all but the most unmineralized waters, and that potassium has never been shown to be a limiting factor for plant growth in streams.

Table 3-8-19 presents ranges of concentration for potassium for the White River and Yellow Creek. The data were reported by Everhart and May (1973) and Weeks and Welder (1974).

i. Silica - According to Hem (1959), most silica in natural waters is derived from the chemical breakdown of mineral silicates in the processes of metamorphism or weathering. Brown et al. (1970) report that silica concentrations of less than 10 mg/l occur frequently, but that waters which drain deposits high in silicate minerals (particularly feldspars) often contain up to 60 mg/l.

Silica is essential for the support of diatoms and dinoflagellates and, as noted by Hutchinson (1957), there is considerable variation in the optimal concentration of silicate required by individual species. Generally, silica concentrations are not limiting to the growth of algae species in streams and rivers.

Table 3-8-19 includes the ranges of silica concentrations observed in the White River and Yellow Creek by Everhart and May (1973) and Weeks and Welder (1974).

j. Sodium - Although nearly all waters contain sodium, its concentration is highly variable and is dependent upon the geological nature of the drainage area. Once sodium has been leached from rock it remains in solution. Small concentrations of sodium are necessary for plant and animal growth but high concentrations can be toxic (Hutchinson, 1957). Toxic levels vary with synergistic and antagonistic interactions between sodium and other chemical factors; McKee and Wolf (1973) report a threshold of toxicity toward freshwater fish of 500 - 1000 mg/l.

Table 3-8-19 presents the ranges of concentration observed for sodium in Yellow Creek and the White River by Everhart and May (1973), Pennak (1974) and Weeks and Welder (1974).

k. Solids (Dissolved, Suspended) - According to EPA (1972), total dissolved solids is a general term used to describe the concentration of dissolved materials in the water. The constituents which are generally the major contributors to total dissolved solids are bicarbonates, carbonates, sulfates, chlorides, phosphates and nitrates. As noted by the FWPCA (1968) aquatic organisms require dissolved materials, since many of these materials are essential for the growth, reproduction, and maintenance of the organisms. EPA (1972) indicated that the presence and relative abundance of dissolved materials are related to surface runoff, precipitation, geochemistry of the watershed, man-created effluents and aquatic chemical and biological processes. Organisms differ in their requirements for various dissolved materials and seldom are the concentrations of such materials at optimum levels. The productivity of a water is therefore related to the concentration of dissolved solids. Dissolved solids serve as nutrients, may induce osmotic stress or may exert direct toxic effects. Changes in the composition or abundance of dissolved solids may therefore induce changes in the structure and function of aquatic ecosystems.

EPA (1972) reported that "in inland waters of the United States which support a mixed biota, 5% have a dissolved solids concentration under 72 mg/l; about 50% under 169 mg/l; and 95% under 400 mg/l." EPA (1972) also indicated that the tolerance limits of fish to total dissolved solids are poorly defined, but that the concentrations of total dissolved solids which can cause osmotic stress in fish are higher than the concentrations generally found in the freshwaters of the U. S.

Turbidity in natural waters is caused by suspended matter (solids). Hynes (1970) suggests that in most streams and rivers the greatest quantities of suspended matter occur during floods. Thus, at times of low flow, streams and rivers normally contain the minimum quantities of suspended matter.

Table 3-8-19 lists determinations of dissolved solids (filterable solids; dissolved inorganic matter) and suspended solids (nonfilterable solids; suspended inorganic matter) as made during 1968 - 1969 and 1973 by Everhart and May (1973), Pennak (1974) and Weeks and Welder (1974).

1. Sulfates - Sulfates are dissolved from most sedimentary rocks. Large quantities of sulfate may result from water coursing over beds of gypsum, sodium sulfate deposits and some types of shale (Brown et al., 1970). Sulfates serve as an essential macronutrient for aquatic biota. However, excessive quantities can be toxic to aquatic life. Thus, McKee and Wolf (1963) report that "good" freshwater game fish populations have been noted to reside in waters containing less than 90 mg/l.

Table 3-8-19 lists ranges of sulfate concentrations observed in the White River and Yellow Creek by Everhart and May (1973), Pennak (1974) and Weeks and Welder (1974).

4. Data Summary

a. Headwaters - Data concerning the chemical characteristics of the Headwater stations are summarized in Tables 3-8-20 through 3-8-25 and in Figures 3-8-4 through 3-8-15.

3-8-72

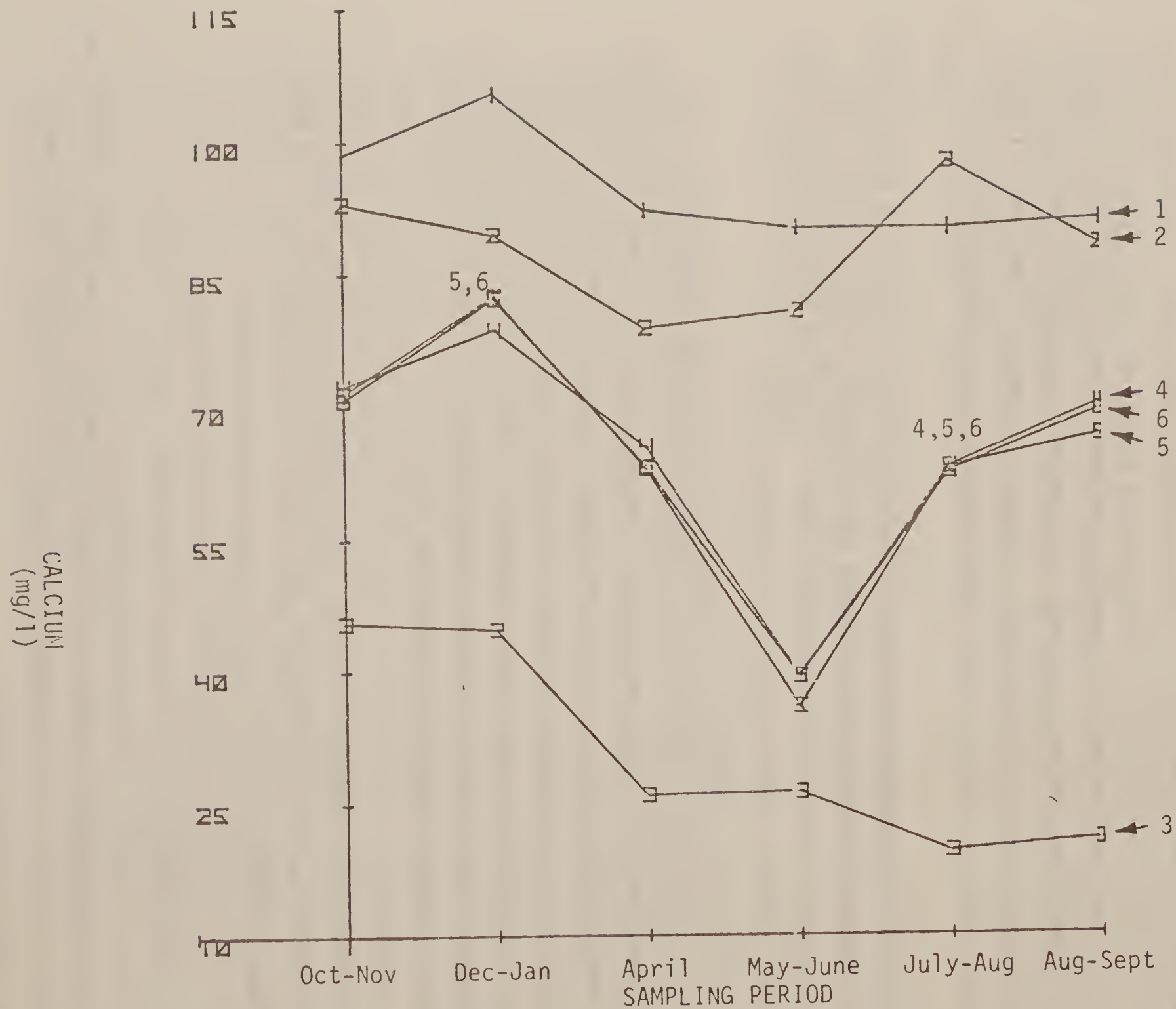


Figure 3-8-4. Mean calcium concentrations for station groups during RBOSP Aquatic Baseline Studies from October - November 1974 to August - September 1975. (Station Group 1 = Headwater; Group 2 = Tract; Group 3 = Yellow Creek; Group 4 = White River above confluence with Yellow Creek; Group 5 = White River at confluence with Yellow Creek; Group 6 = White River below confluence with Yellow Creek)

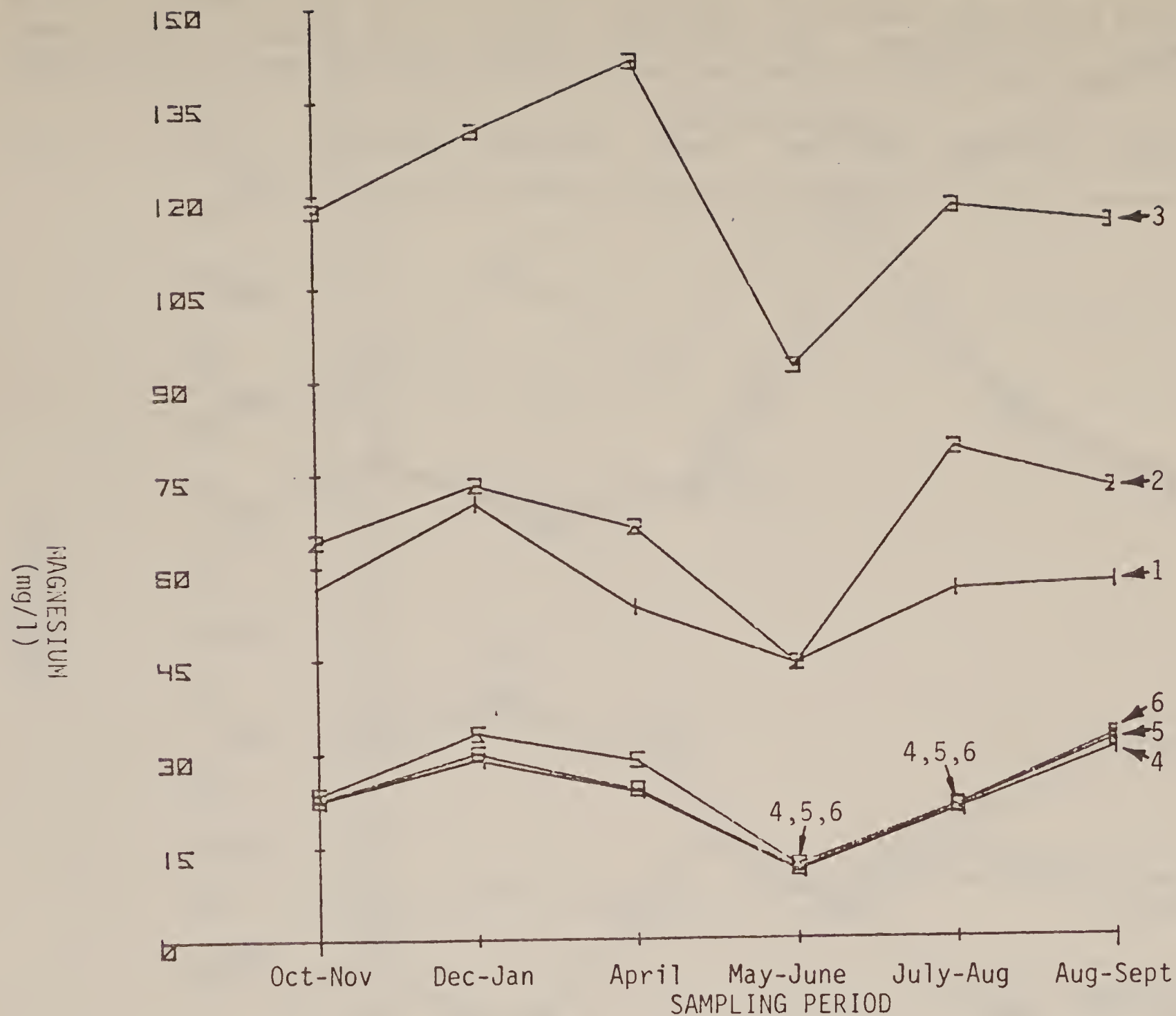


Figure 3-8-5. Mean magnesium concentrations for station groups during RBOSP Aquatic Baseline Studies from October - November 1974 to August - September 1975. (Station Group 1 = Headwater; Group 2 = Tract; Group 3 = Yellow Creek; Group 4 = White River above confluence with Yellow Creek; Group 5 = White River at confluence with Yellow Creek; Group 6 = White River below confluence with Yellow Creek)

3-8-74

HARDNESS
(mg/l CaCO_3)

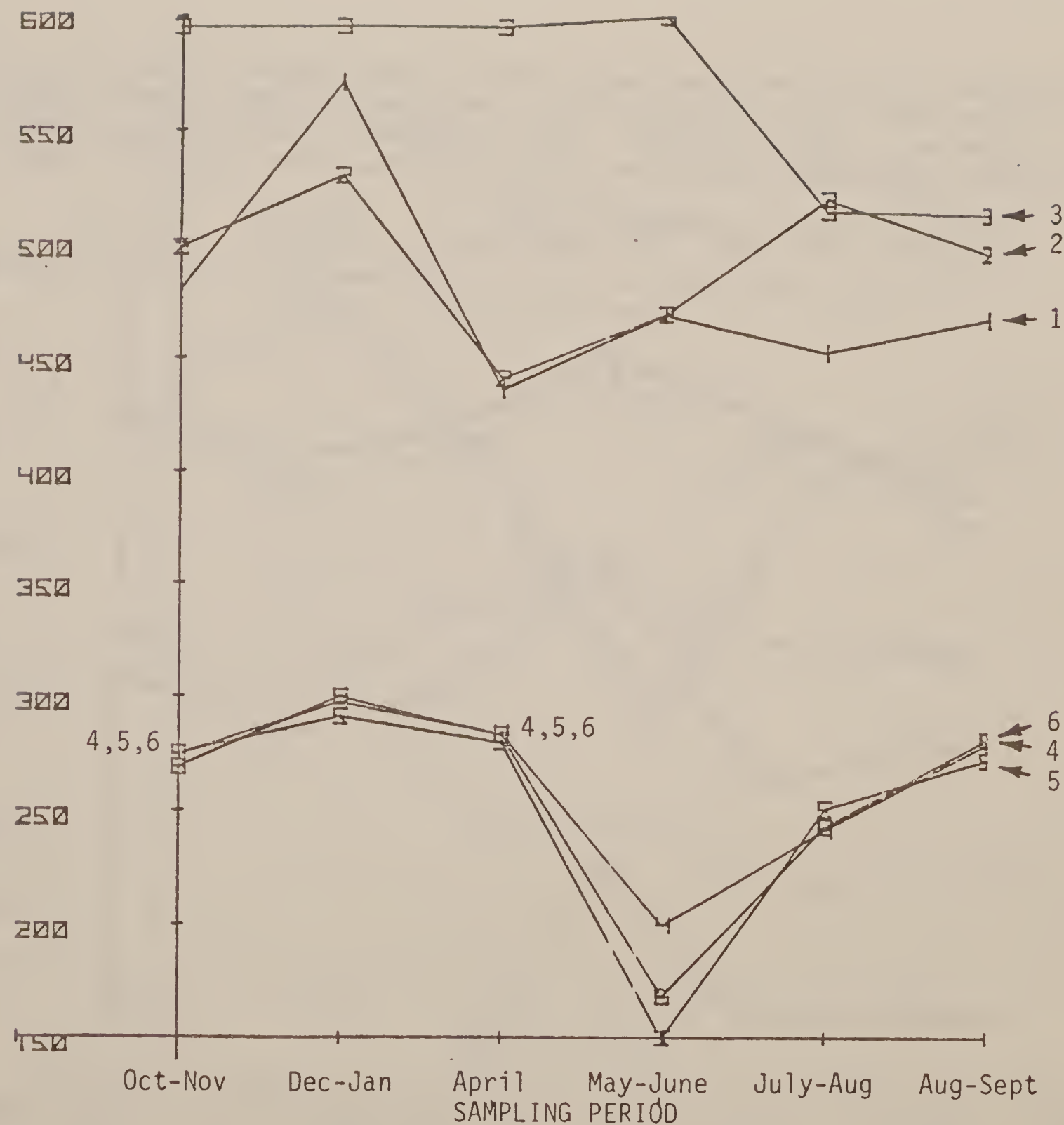


Figure 3-8-6. Mean hardness concentrations for station groups during RBOSP Aquatic Baseline Studies from October - November 1974 to August - September 1975. (Station Group 1 = Hardness; Group 2 = Tract; Group 3 = Yellow Creek; Group 4 = White River above confluence with Yellow Creek; Group 5 = White River at confluence with Yellow Creek; Group 6 = White River below confluence with Yellow Creek)

3-8-75

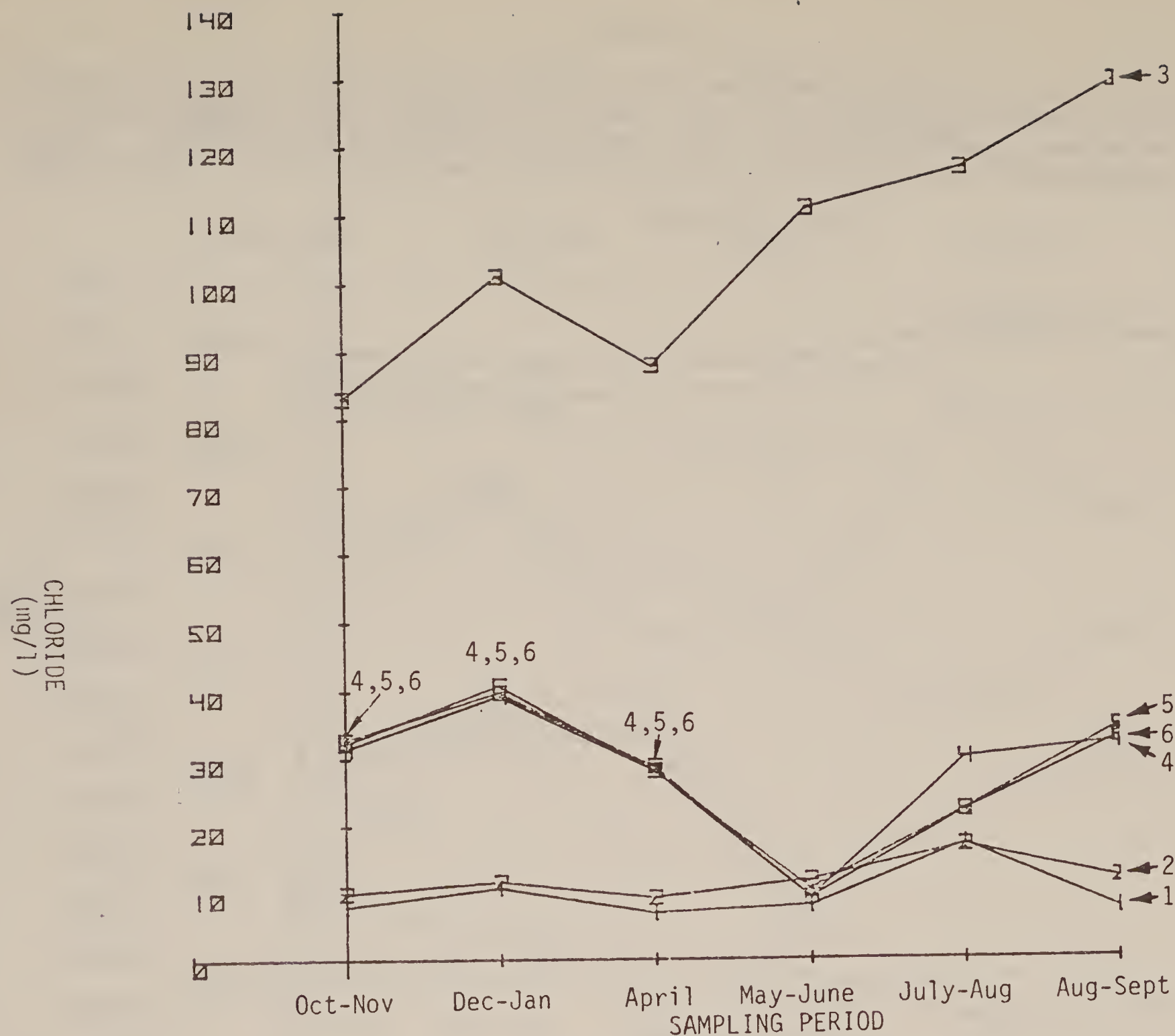


Figure 3-8-7. Mean chloride concentrations for station groups during RBOSP Aquatic Baseline Studies for October - November 1974 to August - September 1975. (Station Group 1 = Headwater; Group 2 = Tract; Group 3 = Yellow Creek; Group 4 = White River above confluence with Yellow Creek; Group 5 = White River at confluence with Yellow Creek; Group 6 = White River below confluence with Yellow Creek)

3-8-76

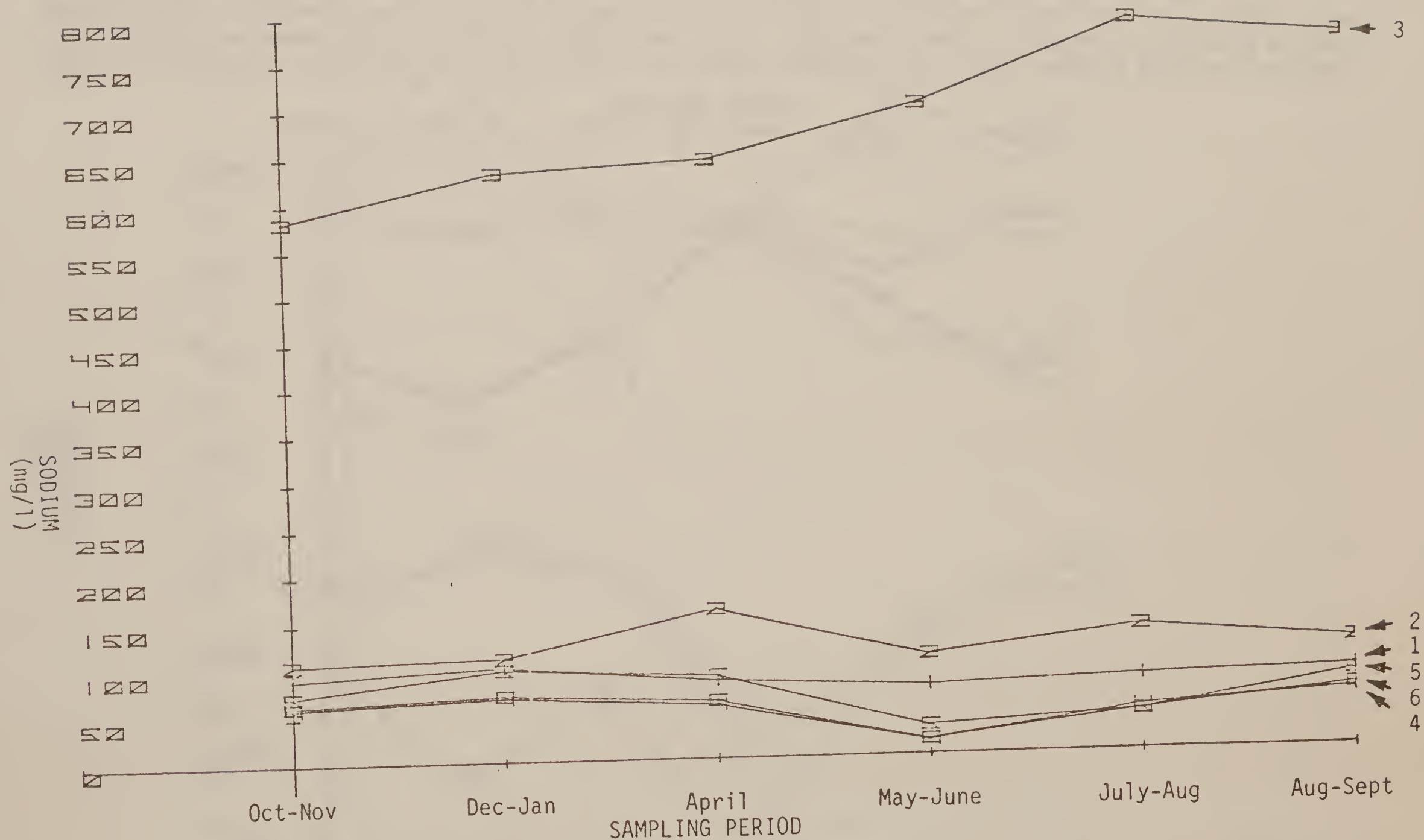


Figure 3-8-8. Mean sodium concentrations for station groups during RBOSP Aquatic Baseline Studies from October - November 1974 to August - September 1975. (Station Group 1 = Headwater; Group 2 = Tract; Group 3 = Yellow Creek; Group 4 = White River above confluence with Yellow Creek; Group 5 = White River at confluence with Yellow Creek; Group 6 = White River below confluence with Yellow Creek)

3-8-77

SULFATE
(mg/l)

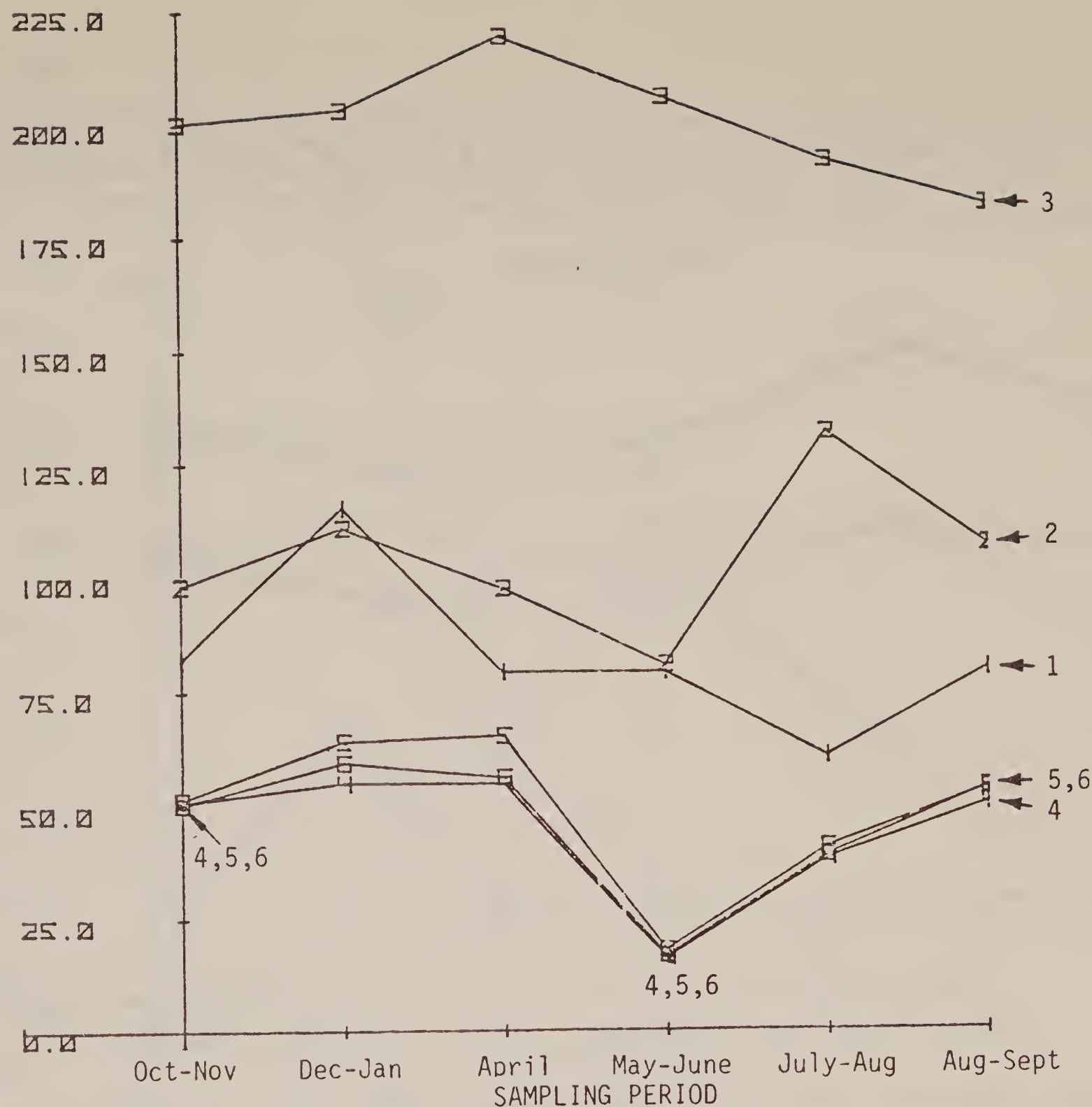


Figure 3-8-9. Mean sulfate concentrations for station groups during RBOSP Aquatic Baseline Studies from October - November 1974 to August - September 1975. (Station Group 1 = Headwater; Group 2 = Tract; Group 3 = Yellow Creek; Group 4 = White River above confluence with Yellow Creek; Group 5 = White River at confluence with Yellow Creek; Group 6 = Below confluence with Yellow Creek)

3-8-78

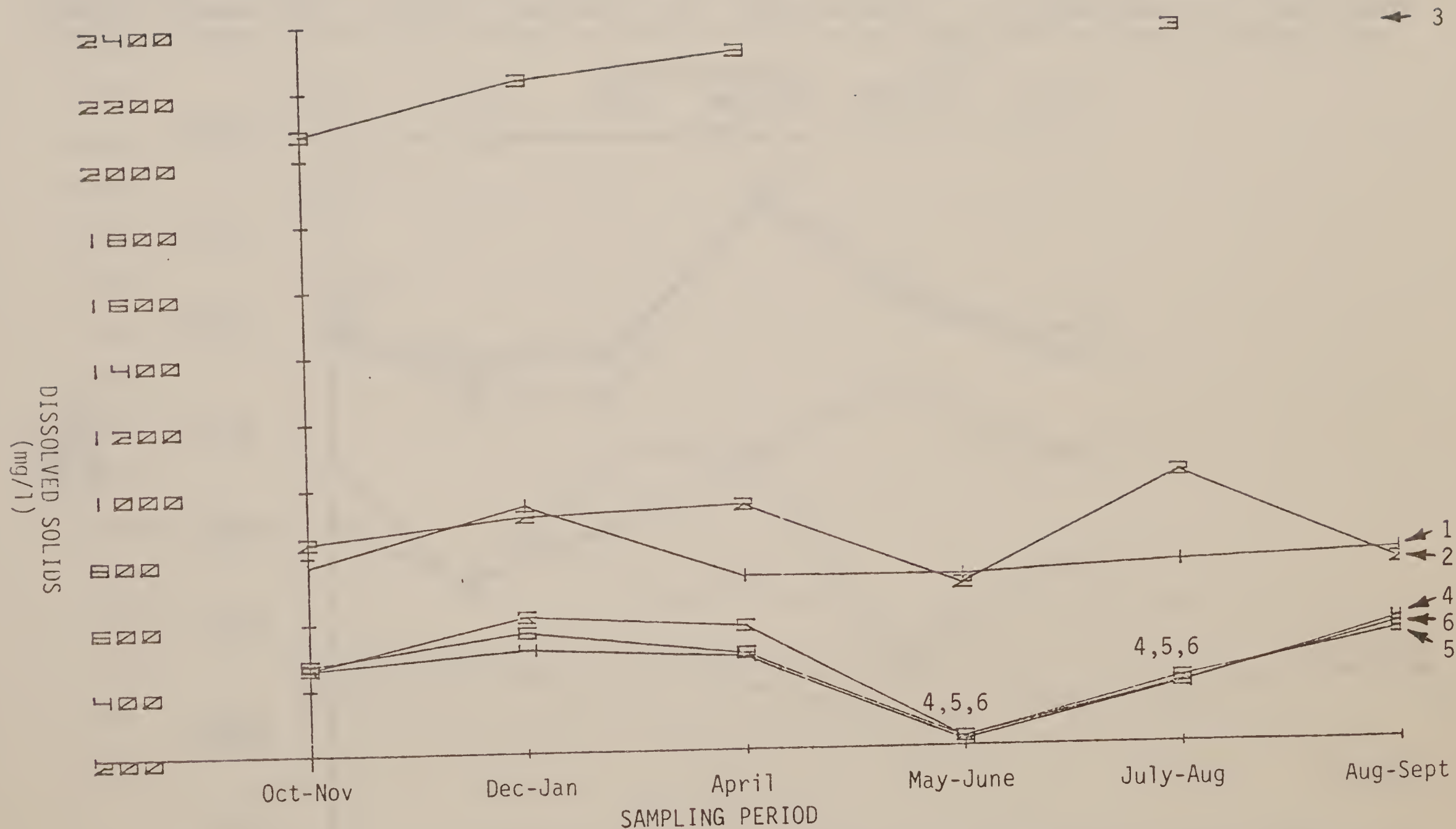


Figure 3-8-10. Mean dissolved solids concentrations for station groups during RBOSP Aquatic Baseline Studies from October - November 1974 to August - September 1975. (Station Group 1 = Headwater; Group 2 = Tract; Group 3 = Yellow Creek; Group 4 = White River above confluence with Yellow Creek; Group 5 = White River at confluence with Yellow Creek; Group 6 = White River below confluence with Yellow Creek)

3-8-79

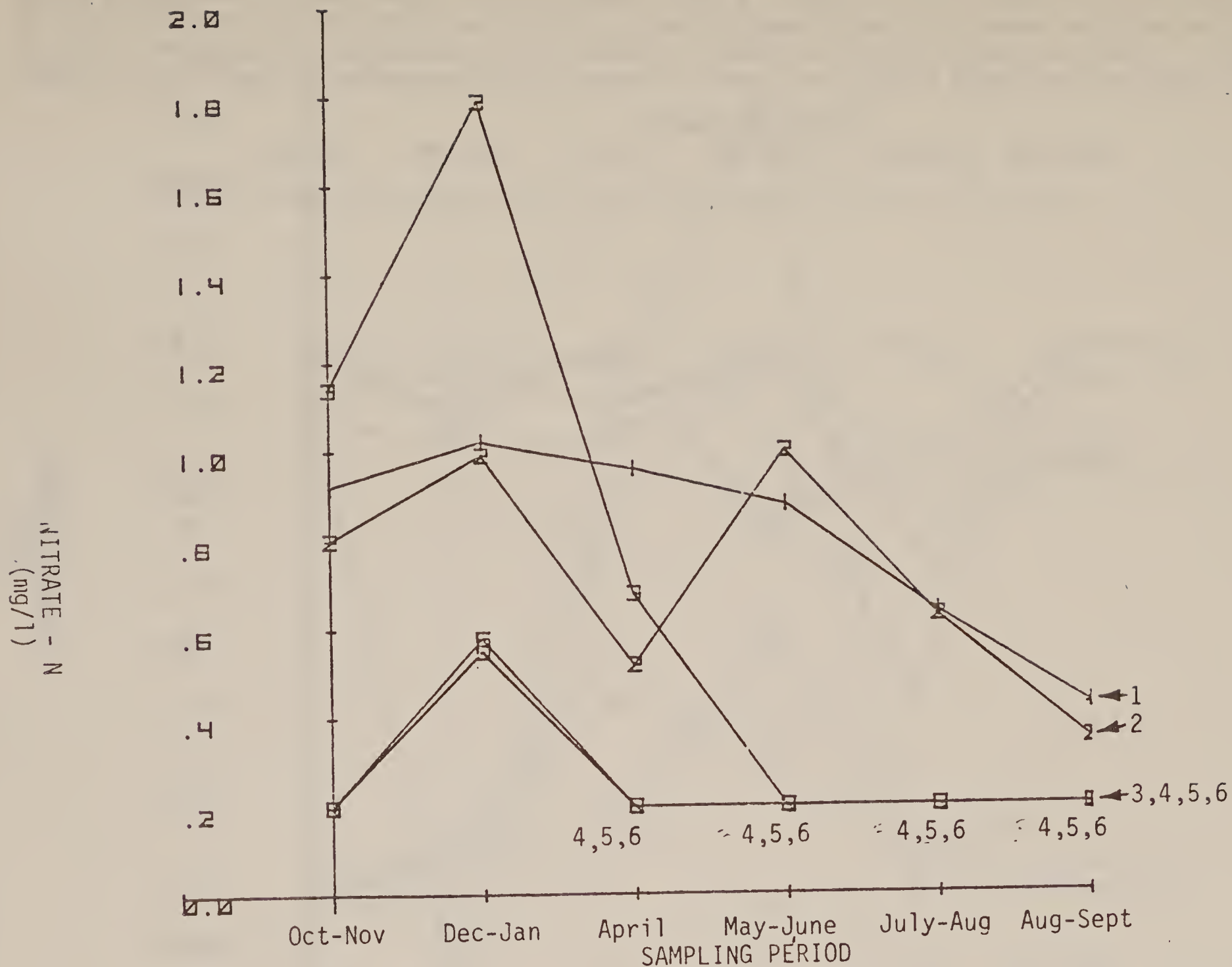


Figure 3-8-11. Mean nitrate (N) concentrations for station groups during RBOSP Aquatic Baseline Studies from October - November 1974 to August - September 1975. (Station Group 1 = Headwater; Group 2 = Tract; Group 3 = Yellow Creek; Group 4 = White River above confluence with Yellow Creek; Group 5 = White River at confluence with Yellow Creek; Group 6 = White River below confluence with Yellow Creek)

3-8-80

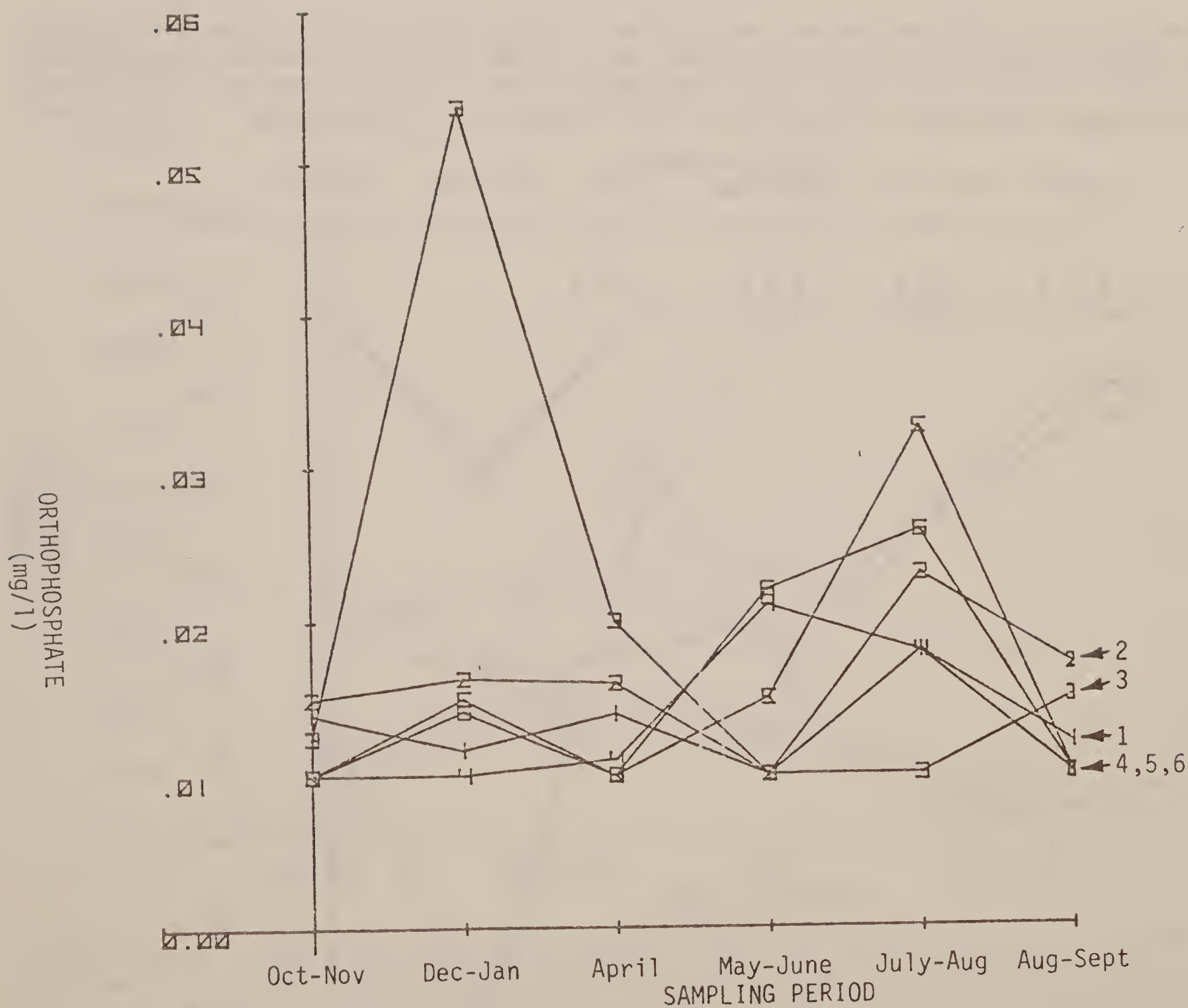


Figure 3-8-12. Mean orthophosphate (P) concentrations for station groups during RBOSP Aquatic Baseline Studies from October - November 1974 to August - September 1975. (Station Group 1 = Headwater; Group 2 = Tract; Group 3 = Yellow Creek; Group 4 = White River above confluence with Yellow Creek; Group 5 = White River at confluence with Yellow Creek; Group 6 = White River below confluence with Yellow Creek)

3-8-81

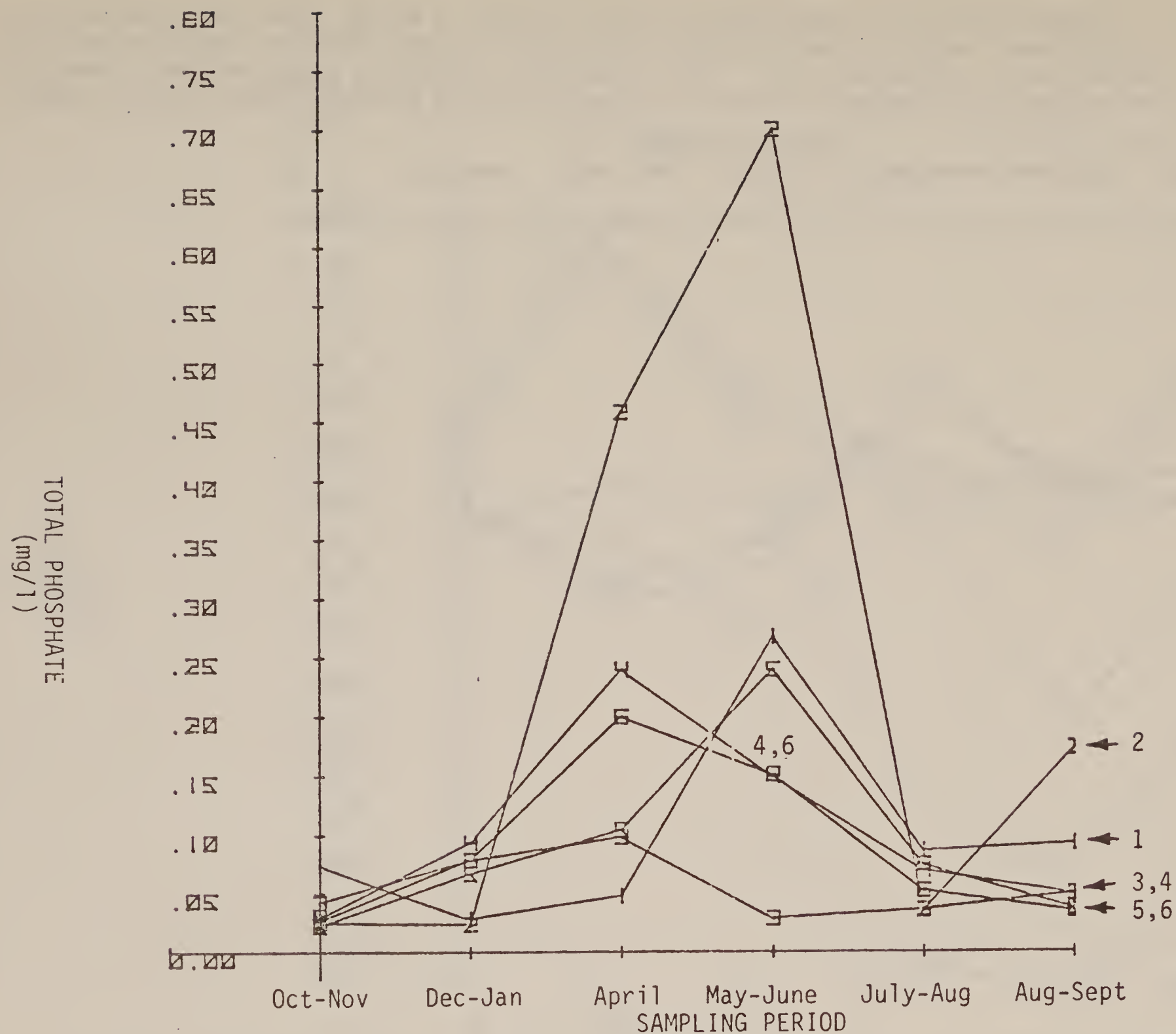


Figure 3-8-13. Mean total phosphate (p) concentrations for station groups during RBOSP Aquatic Baseline Studies from October - November 1974 to August - September 1975. (Station Group 1 = Headwater; Group 2 = Tract; Group 3 = Yellow Creek; Group 4 = White River above confluence with Yellow Creek; Group 5 = White River at confluence with Yellow Creek; Group 6 = White River below confluence with Yellow Creek)

3-8-82

POTASSIUM
(mg/l)

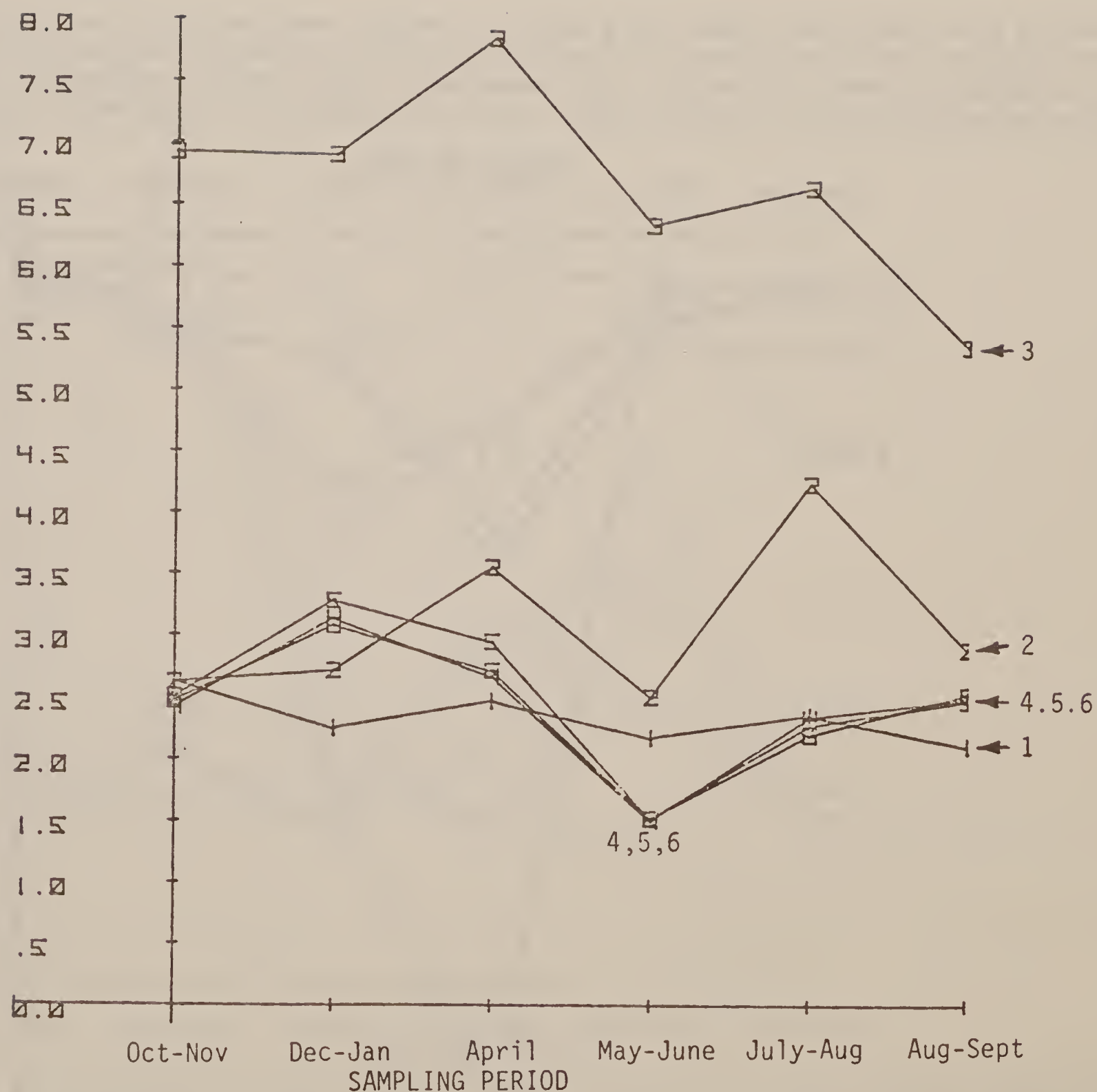


Figure 3-8-14. Mean potassium concentrations for station groups during RBOSP Aquatic Baseline Studies from October - November 1974 to August - September 1975. (Station Group 1 = Headwater; Group 2 = Tract; Group 3 = Yellow Creek; Group 4 = White River above confluence with Yellow Creek; Group 5 = White River at confluence with Yellow Creek; Group 6 = White River at confluence with Yellow Creek)

3-8-83

SILICA
(mg/l)

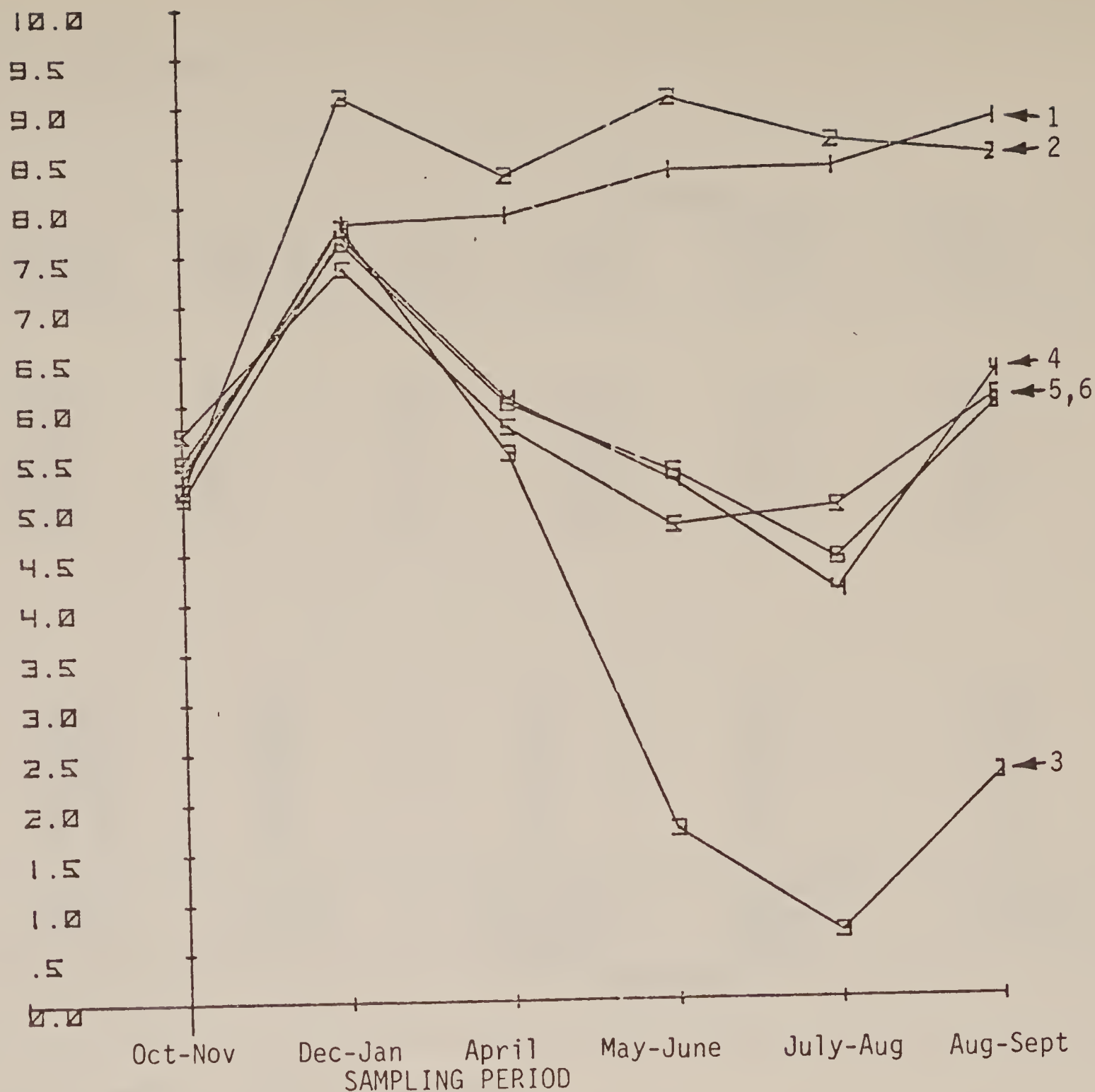


Figure 3-8-15. Mean silica concentrations for station groups during RBOSP Aquatic Baseline Studies from October-November 1974 to August-September 1975. (Station Group 1 = Headwater; Group 2 = Tract; Group 3 = Yellow Creek; Group 4 = White River above confluence with Yellow Creek; Group 5 = White River at confluence with Yellow Creek; Group 6 = White River below confluence with Yellow Creek)

Table 3-8-20. Water chemistry data obtained at the Headwater Stations during RBOSP Aquatic Baseline Studies, October 1974 - November 1974. Results are expressed in mg/l (unless otherwise noted) and are the means of duplicate analyses.

Station	Parameter					
	Ammonia (N)	Calcium (Ca)	Organic Carbon(C) Dissolved	Total Organic Carbon(C)	Chloride (Cl)	Color (APHA)
1	<0.10	94	23	19	3.5	0-5
2	<0.10	85	21	18	5.5	0-5
3	<0.10	91	30	60	10.5	0-5
4	<0.10	115	19	23	4.0	0-5
5	<0.10	108	24	30	12.0	0-5

Table 3-8-20. (Continued)

Station	Parameter						
	Hardness (CaCO ₃)	Magnesium (Mg)	Nitrate (N)	Nitrite (N)	Kjeldahl Nitrogen (N)	Ortho Phosphate (P)	Total Phosphate (P)
1	430	48	0.9	<0.01	0.30	<0.01	0.02
2	400	45	<0.2	<0.01	0.27	<0.01	0.05
3	455	55	2.1	0.01	1.90	0.03	0.26
4	520	57	1.1	<0.01	0.31	0.02	0.04
5	590	78	0.5	<0.01	0.24	<0.01	0.02

Table 3-8-20. (Continued)

Station	Parameter						
	Potassium (K)	Soluble Silica (Si)	Sodium (Na)	Dissolved Solids	Suspended Solids	Sulfate (S)	Turbidity (JTU)
1	1.5	5.1	50	570	7	43	3
2	1.2	5.9	88	650	4	46	2
3	4.7	2.9	100	820	76	97	20
4	1.9	9.5	88	823	14	86	5
5	4.0	3.0	132	1000	14	140	2

Table 3-8-21. Water chemistry data obtained at the Headwater Stations during RBOSP Aquatic Baseline Studies, December 1974 - January 1975. Results are expressed in mg/l (unless otherwise noted) and are the means of duplicate analyses.

Station	Parameter					
	Ammonia (N)	Calcium (Ca)	Organic Carbon(C) Dissolved	Total Organic Carbon(C)	Chloride (Cl)	Color (APHA)
3	<0.10	109	9	19	13.5	0-5
4	<0.10	105	11	14	7.0	0-5
5	<0.10	102	12	17	11.5	0-5

¹Stations 1 & 2 were inaccessible at time of sampling.

Table 3-8-21. (Continued)

Station	Parameter						
	Hardness (CaCO ₃)	Magnesium (Mg)	Nitrate (N)	Nitrite (N)	Kjeldahl Nitrogen (N)	Ortho Phosphate (P)	Total Phosphate (P)
3	611	70	0.2	<0.01	0.10	0.02	0.04
4	515	61	1.6	<0.01	0.24	0.01	0.03
5	586	80	1.3	<0.01	0.22	0.01	0.03

Table 3-8 -21. (Continued)

Station	Parameter						
	Potassium (K)	Soluble Silica (Si)	Sodium (Na)	Dissolved Solids	Suspended Solids	Sulfate (S)	Turbidity (JTU)
3	2.5	9.2	112	960	4	114	1
4	2.0	7.9	75	812	15	91	2
5	2.3	6.4	121	540	<1	142	1

Table 3-8-22. Water chemistry data obtained at the Headwater Stations during RBOSP Aquatic Baseline Studies, April, 1975. Results are expressed in mg/l (unless otherwise noted) and are the means of duplicate analyses.

Station	Parameter					
	Ammonia (N)	Calcium (Ca)	Organic Carbon(C) Dissolved	Total Organic Carbon(C)	Chloride (Cl)	Color (APHA)
1	<0.10	95	19	23	5.9	10-20
2	<0.10	102	12	22	6.2	10-20
3	<0.10	52	14	22	5.2	10-20
4	<0.10	110	19	25	6.4	0-5
5	<0.10	102	17	22	11.0	5-10

Table 3-8-22. (Continued)

Station	Parameter						
	Hardness (CaCO ₃)	Magnesium (Mg)	Nitrate (N)	Nitrite (N)	Kjeldahl Nitrogen (N)	Ortho- Phosphate (P)	Total Phosphate (P)
1	415	45	2.0	<0.01	0.28	0.02	0.02
2	480	52	1.1	0.03	0.35	<0.01	0.04
3	260	31	<0.2	<0.01	0.55	0.02	0.13
4	460	59	1.4	<0.01	0.26	0.01	0.03
5	565	80	<0.2	<0.01	0.55	<0.01	0.03

Table 3-3-22. (Continued)

Station	Parameter						
	Potassium (K)	Soluble Silica (Si)	Sodium (Na)	Dissolved Solids	Suspended Solids	Sulfate (S)	Turbidity (JTU)
1	1.5	10.3	40	550	1	37	1
2	1.7	9.7	83	763	52	85	1
3	2.4	5.7	67	478	271	51	37
4	2.6	8.3	93	855	6	88	2
5	4.3	5.4	142	1,000	4	137	1

Table 3-8-23. Water chemistry data obtained at the Headwater Stations during RBOSP Aquatic Baseline Studies, May 1975 - June 1975. Results are expressed in mg/l (unless otherwise noted) and are the means of duplicate analyses.

Station	Parameter					
	Ammonia (N)	Calcium (Ca)	Organic Carbon(C) Dissolved	Total Organic Carbon(C)	Chloride (Cl)	Color (APHA)
1	<0.1	86	23	22	5.0	5-10
2	<0.1	90	12	13	8.0	10-20
3	<0.1	88	6	8	11.0	10-20
4	<0.1	102	9	37	6.0	30-40
5	<0.1	84	6	9	11.0	20-30

Table 3-8-23. (Continued)

Station	Parameter						
	Hardness (CaCO ₃)	Magnesium (Mg)	Nitrate (N)	Nitrite (N)	Kjeldahl Nitrogen (N)	Ortho Phosphate (P)	Total Phosphate (P)
1	420	42	1.3	<0.01	0.52	<0.01	0.02
2	410	41	1.1	<0.01	0.26	<0.01	0.02
3	470	46	<0.2	<0.01	1.00	<0.01	0.12
4	485	45	1.7	<0.01	2.30	0.01	1.15
5	560	48	<0.2	<0.01	0.44	<0.01	0.03

Table 3-8-23. (Continued)

Station	Parameter						
	Potassium (K)	Soluble Silica (Si)	Sodium (Na)	Dissolved Solids	Suspended Solids	Sulfate (S)	Turbidity (JTU)
1	1.4	9.5	36	546	8	41	1
2	1.1	9.8	45	563	<2	44	2
3	2.7	8.4	105	823	55	96	19
4	2.4	10.1	68	704	1,100	78	87
5	3.4	3.9	125	981	1	138	2

Table 3-8-24. Water chemistry data obtained at the Headwater Stations during RBOSP Aquatic Baseline Studies, July 1975 - August 1975. Results are expressed in mg/l (unless otherwise noted) and are the means of duplicate analyses.

Station	Parameter					
	Ammonia (N)	Calcium (Ca)	Organic Carbon(C) Dissolved	Total Organic Carbon(C)	Chloride (Cl)	Color (APHA)
1	<0.10	84	11	19	4.0	10-20
2	<0.10	90	14	8	29.0	5-10
3	<0.10	88	8	7	15.0	10-20
4	<0.10	103	10	6	28.0	5-10
5	<0.10	85	11	10	11.7	20-30

Table 3-8-24. (Continued)

Station	Parameter						
	Hardness (CaCO ₃)	Magnesium (Mg)	Nitrate (N)	Nitrite (N)	Kjeldahl Nitrogen (N)	Ortho Phosphate (P)	Total Phosphate (P)
1	423	46	0.7	<0.01	0.83	0.03	0.12
2	430	45	0.8	0.06	0.30	<0.01	0.09
3	430	56	<0.2	<0.01	0.87	0.02	0.15
4	458	57	1.4	<0.01	0.23	0.03	0.04
5	524	76	0.2	<0.01	0.64	0.02	0.05

Table 3-8 -24. (Continued)

Station	Parameter						Turbidity (JTU)
	Potassium (K)	Soluble Silica (Si)	Sodium (Na)	Dissolved Solids	Suspended Solids	Sulfate (S)	
1	1.8	9.7	40	570	389	39	83
2	1.3	10.0	61	618	22	54	1
3	2.9	8.2	99	816	15	94	7
4	1.9	9.4	78	797	8	88	1
5	4.1	4.4	130	969	9	32	3

Table 3-8-25. Water chemistry data obtained at the Headwater Stations during RBOSP Aquatic Baseline Studies, August 1975 - September 1975. Results are expressed in mg/l (unless otherwise noted) and are the means of duplicate analyses.

Station	Parameter					
	Ammonia (N)	Calcium (Ca)	Organic Carbon(C) Dissolved	Total Organic Carbon(C)	Chloride (Cl)	Color (APHA)
1	0.10	97	<1	<1	4.3	10-20
2	0.10	87	<1	<1	4.4	10-20
3	0.11	80	<2	8	12.0	20-30
4	0.10	104	<1	<1	6.1	10-20
5	0.25	87	<1	<1	11.0	10-20

Table 3-8-25. (Continued)

Station	Parameter						
	Hardness (CaCO ₃)	Magnesium (Mg)	Nitrate (N)	Nitrite (N)	Kjeldahl Nitrogen (N)	Ortho Phosphate (P)	Total Phosphate (P)
1	430	48	1.1	<0.01	0.61	<0.01	0.05
2	396	44	<0.2	<0.01	0.33	<0.01	0.06
3	449	54	<0.2	<0.01	3.15	<0.01	0.29
4	516	58	0.5	<0.01	0.38	0.02	0.08
5	545	82	<0.2	<0.01	0.38	<0.01	0.01

Table 3-8-25. (Continued)

Station	Parameter						
	Potassium (K)	Soluble Silica (Si)	Sodium (Na)	Dissolved Solids	Suspended Solids	Sulfate (S)	Turbidity (JTU)
1	0.7	10.0	43	607	47	41	12
2	1.0	11.0	72	628	32	51	3
3	5.6	8.6	101	829	382	91	85
4	1.5	10.0	84	825	39,	84	6
5	2.0	4.7	130	964	2	134	1

At the Headwater stations, mean calcium concentrations at individual stations ranged from 52 mg/l during April 1975 (Table 3-8-22) to 115 mg/l during October - November 1974 (Table 3-8-20). Calcium concentrations at the Headwater stations were generally lowest during April 1975 and highest during December 1975 (Figure 3-8-4).

Mean chloride concentrations at the individual Headwater stations ranged from 4 mg/l during October - November 1974 (Table 3-8-20) to 29 mg/l during July - August 1975 (Table 3-8-24). Figure 3-8-5 indicates that, although chloride concentrations were relatively constant between sampling periods, in general the lowest concentrations were observed during the April 1975 sampling period and the highest concentrations were found during July - August (Figure 3-8-5).

Total organic carbon concentrations at individual stations ranged from less than 1 mg/l during August - September 1975 (Table 3-8-25) to 60 mg/l during October - November 1974 (Table 3-8-20).

Dissolved organic carbon concentrations at individual stations ranged from less than 1 mg/l during August - September 1975 (Table 3-8-25) to 30 mg/l during October - November 1974 (Table 3-8-20).

Hardness (expressed as CaCO_3) at the Headwater stations ranged from 260 mg/l during April 1975 (Table 3-8-22) to 611 mg/l during December 1974 - January 1975 (Table 3-8-21). Hardness was generally lowest during April 1975 and highest during December 1974 - January 1975 (Figure 3-8-6)

Mean concentrations of magnesium at individual Headwater stations ranged from 31 mg/l in April 1975 (Table 3-8-22) to 82 mg/l during August - September 1975. Magnesium concentrations were generally lowest during May - June 1975 and highest during December 1974 - January 1975 (Figure 3-8-7).

At the Headwater stations, mean concentrations of nitrate nitrogen ranged from less than 0.2 mg/l during several sampling periods to 2.1 mg/l during

the October - November 1974 sampling period (Table 3-8-20). The lowest concentrations of nitrate nitrogen were recorded during August - September 1975, whereas the highest concentrations were found during December 1974 - January 1975 (Figure 3-8-3).

Mean concentrations of nitrite nitrogen at individual Headwater stations ranged from less than 0.01 mg/l during most sampling periods to 0.06 mg/l during the July - August 1975 period (Table 3-8-24). Nitrite concentrations did not vary appreciably among sampling periods at any of the Headwater stations, except at Station 2.

Mean concentrations of ammonia nitrogen at the Headwater stations ranged from less than 0.10 mg/l during most sampling periods to 0.25 mg/l during August - September 1975 (Table 3-8-25). Ammonia nitrogen concentrations were generally low during the one year of study, increasing somewhat during August - September 1975.

Mean concentrations of Kjeldahl nitrogen at individual stations ranged from 0.10 mg/l during December 1974 - January 1975 (Table 3-8-21) to 3.15 mg/l during August - September 1975 (Table 3-8-25). Kjeldahl nitrogen concentrations were generally lowest during December 1974 - January 1975 and highest during August - September 1975.

The concentration of orthophosphate (as P) at individual stations ranged from less than 0.01 mg/l during several sampling periods to 0.03 mg/l during October - November 1974 (Table 3-8-20) and July - August 1975 (Table 3-8-24). Orthophosphate concentrations at the Headwater stations were generally lowest during May - June 1975 and highest during July - August 1975 (Figure 3-8-9). In general, there was little variation in orthophosphate concentrations at the Headwater stations.

The concentration of total phosphate (as P) at the Headwater stations ranged from 0.101 mg/l during August - September 1975 (Table 3-8-25) to 1.15 mg/l during May - June 1975 (Table 3-8-23). The total phosphate concentrations

at Station 3 were generally higher than at the other Headwater stations. Total phosphate concentrations were generally lowest during December 1974 - January 1975 and highest during May - June 1975 (Figure 3-8-10).

Mean potassium concentrations at the individual Headwater stations ranged from 1.0 mg/l to 5.6 mg/l during the same sampling period (August - September 1975) (Table 3-8-25). Potassium concentrations generally appeared to be somewhat higher at Station 5 than at the other Headwater stations. Potassium concentrations at the Headwater stations did not vary greatly among sampling periods (Figure 3-8-11). The highest overall potassium concentrations were recorded during October - November 1974 and the lowest were observed during August - September 1975.

Mean soluble silica concentrations (as Si) at the Headwater stations ranged from 2.9 mg/l during October - November 1974 (Table 3-8-20) to 11.0 mg/l during August - September 1975 (Table 3-8-25). Soluble silica concentrations at the Headwater stations generally increased over the one-year period included in this report. Thus, the lowest overall silica concentration for the Headwater stations was recorded during October - November 1974 whereas the overall concentration was observed in August - September 1975 (Figure 3-8-12).

Mean sodium concentrations at individual stations ranged from 36 mg/l during May - June 1975 (Table 3-8-23) to 142 mg/l during April 1975 (Table 3-8-22). Sodium concentrations at Station 5 were generally higher than those at other Headwater stations during the one-year period. In general, sodium concentrations at the Headwater stations did not vary greatly among sampling periods (Figure 3-8-13).

The mean concentration of dissolved solids at individual Headwater stations ranged from 478 mg/l during April 1975 (Table 3-8-22) to 1,000 mg/l during both October - November 1974 (Table 3-8-20) and April 1975 (Table 3-8-22). In general, lowest dissolved solids concentrations were recorded during April 1975 and the highest concentrations were observed during December 1974 - January 1975 (Figure 3-8-14).

Suspended solids concentrations at the Headwater stations varied from less than 1 mg/l in December 1974 - January 1975 (Table 3-8-21) to 1,100 mg/l during the May - June 1975 (Table 3-8-23). The quantity of suspended solids varied greatly among sampling sites during each sampling period. The lowest concentration of suspended solids for the Headwater (as a group) was observed in December 1974 - January 1975; the highest occurred in August - September 1975.

Mean sulfate concentrations (as S) at the Headwater stations ranged from 32 mg/l in July - August 1975 (Table 3-8-24) to 142 mg/l in December 1974 - January 1975 (Table 3-8-21). The lowest overall concentrations were observed during July - August 1975 and the highest concentrations were recorded during December 1974 - January 1975 (Figure 3-8-15).

b. Tract C-a - A summary of the data related to chemical characteristics of the stations on or near Tract C-a is presented in Tables 3-8-26 through 3-8-31 and in Figure 3-8-1 through 3-8-12.

At the Tract stations, mean calcium concentrations ranged from 54 mg/l during April 1975 (Table 3-8-28) to 141 mg/l during July - August 1975 (Table 3-8-30). Calcium concentrations were generally lowest at the Tract stations during April 1975 and highest during July - August 1975 (Figure 3-8-1).

Chloride concentrations at the Tract stations ranged from 6 mg/l during the May - June 1975 sampling (Table 3-8-29) to 33 mg/l during the same sampling. Over the year, mean chloride concentrations were generally higher at Station 14 than at the other Tract stations. In general, chloride concentrations were somewhat lower during April 1975 and higher during July - August 1975 (Figure 3-8-2).

Total organic carbon concentrations at the Tract stations ranged from less than 1 mg/l during August - September 1975 (Table 3-8-31) to 91 mg/l in April 1975 (Table 3-8-28). In general, the lowest concentrations of total

Table 3-8-26. Water chemistry data obtained at the Tract Stations during RBOSP Aquatic Baseline Studies, October 1974 - November 1974. Results are expressed in mg/l (unless otherwise noted) and are the means of duplicate analyses.

Station	Parameter					
	Ammonia (N)	Calcium (Ca)	Organic Carbon(C) Dissolved	Total Organic Carbon(C)	Chloride (Cl)	Color (APHA)
7	<0.10	84	16	21	11.5	0-5
8	<0.10	88	20	28	7.0	0-5
9	<0.10	94	21	26	7.0	0-5
13	<0.10	88	21	18	8.0	0-5
14	<0.10	111	19	33	16.0	0-5

¹ Stations 6, 10 - 12 and 16 - 18 were dry at the time of sampling.

Table 3-8-26. (Continued)

Station	Parameter						
	Hardness (CaCO ₃)	Magnesium (Mg)	Nitrate (N)	Nitrite (N)	Kjeldahl Nitrogen (N)	Ortho Phosphate (P)	Total Phosphate (P)
7	440	56	0.8	<0.01	0.24	0.01	0.03
8	440	53	1.0	<0.01	0.13	0.02	0.02
9	475	58	0.9	<0.01	0.27	<0.01	0.03
13	470	60	0.7	<0.01	0.23	0.03	0.04
14	665	94	0.8	<0.01	0.42	<0.01	0.02

Table 3-8-26. (Continued).

Station	Parameter						
	Potassium (K)	Soluble Silica (Si)	Sodium (Na)	Dissolved Solids	Suspended Solids	Sulfate (S)	Turbidity (JTU)
7	2.1	8.9	90	697	55	88	20
8	2.0	4.4	76	679	22	69	1
9	2.5	4.6	98	803	5	90	2
13	2.6	4.6	21	831	2	91	2
14	3.9	3.3	19	1200	8	153	1

Table 3-8-27. Water chemistry data obtained at the Tract Stations during RBOSP Aquatic Baseline Studies, December 1974 - January 1975. Results are expressed in mg/l (unless otherwise noted) and are the means of duplicate analyses.

Station	Parameter					
	Ammonia (N)	Calcium (Ca)	Organic Carbon(C) Dissolved	Total Organic Carbon(C)	Chloride (Cl)	Color (APHA)
8	<0.10	85	10	9	8.0	0-5
9	<0.10	77	11	5	9.0	0-5
13	<0.10	85	11	11	10.0	0-5
14	<0.10	111	32	19	20.0	0-5

Table 3-8-27. (Continued)

Station	Parameter						
	Hardness (CaCO ₃)	Magnesium (Mg)	Nitrate (N)	Nitrite (N)	Kjeldahl Nitrogen (N)	Ortho Phosphate (P)	Total Phosphate (P)
8	429	55	1.0	0.01	0.18	0.02	0.04
9	459	61	0.9	0.01	0.14	0.01	0.02
13	507	67	0.8	0.01	0.18	0.03	0.03
14	724	111	1.4	0.01	0.30,	<0.01	<0.01

Table 3-8-27. (Continued)

Station	Parameter						
	Potassium (K)	Soluble Silica (Si)	Sodium (Na)	Dissolved Solids	Suspended Solids	Sulfate (S)	Turbidity (JTU)
8	2.0	9.3	77	724	3	74	1
9	2.6	9.2	91	876	3	95	1
13	2.6	10.0	110	842	<1	96	1
14	3.7	7.9	171	1272	5	180	1

Table 3-8-28. Water chemistry data obtained at the Tract Stations during RBOSP Aquatic Baseline Studies, April, 1975. Results are expressed in mg/l (unless otherwise noted) and are the means of duplicate analyses.

Station ¹	Parameter					
	Ammonia (N)	Calcium (Ca)	Organic Carbon(C) Dissolved	Total Organic Carbon(C)	Chloride (Cl)	Color (APHA)
7	<0.10	68	15	19	6.1	10-20
8	<0.10	84	16	16	6.5	0-5
9	<0.10	88	16	16	7.4	0-5
13	<0.10	54	40	91	9.6	10-20
14	<0.10	100	29	34	17.0	5-10

¹ Stations 10-12, 15-18 were dry at the time of sampling.

Table 3-8-28. (Continued)

Station ¹	Parameter						
	Hardness (CaCO ₃)	Magnesium (Mg)	Nitrate (N)	Nitrite (N)	Kjeldahl Nitrogen (N)	Ortho Phosphate (P)	Total Phosphate (P)
7	385	52	0.6	<0.01	0.18	<0.01	0.19
8	415	58	0.6	<0.01	0.25	<0.01	0.03
9	450	63	0.6	<0.01	0.21	<0.01	0.02
13	360	54	0.2	<0.01	1.78	0.04	2.00
14	595	105	0.6	<0.01	0.41	<0.01	0.05

Table 3-8-28. (Continued)

Station	Parameter						
	Potassium (K)	Soluble Silica (Si)	Sodium (Na)	Dissolved Solids	Suspended Solids	Sulfate (S)	Turbidity (JTU)
7	2.4	8.8	82	643	320	72	445
8	2.5	8.9	90	723	3	72	2
9	3.3	8.0	108	845	22	94	2
13	4.4	8.9	345	1200	1850	79	>1
14	5.2	6.9	180	1300	25	172	9

Table 3-8-29. Water chemistry data obtained at the Tract Stations during RBOSP Aquatic Baseline Studies, May, 1975 - June, 1975. Results are expressed in mg/l (unless otherwise noted) and are the means of duplicate analyses.

Station ¹	Parameter					
	Ammonia (N)	Calcium (Ca)	Organic Carbon(C) Dissolved	Total Organic Carbon(C)	Chloride (Cl)	Color (APHA)
6	<0.1	78	10	13	6.0	30-40
7	<0.1	84	9	24	6.0	30-40
8	<0.1	78	11	25	6.0	30-40
9	<0.1	78	8	19	7.0	20-30
13	<0.1	64	44	82	14.0	20-30
14	<0.1	103	37	38	33.0	10-20

¹Stations 10 - 12 were dry at the time of sampling.

Table 3-8-29. (Continued)

Station	Parameter						
	Hardness (CaCO ₃)	Magnesium (Mg)	Nitrate (N)	Nitrite (N)	Kjeldahl Nitrogen (N)	Ortho Phosphate (P)	Total Phosphate (P)
6	405	41	1.1	<0.01	2.00	<0.01	0.63
7	470	45	1.5	<0.01	2.30	<0.01	1.00
8	390	42	1.1	<0.01	1.27	<0.01	0.85
9	450	45	1.2	0.01	0.86	<0.01	0.27
13	410	43	0.8	0.02	2.50	0.01	1.75
14	690	50	0.5	0.01	0.33	<0.01	0.02

Table 3-8-29. (Continued)

Station	Parameter						
	Potassium (K)	Soluble Silica (Si)	Sodium (Na)	Dissolved Solids	Suspended Solids	Sulfate (S)	Turbidity (JTU)
6	1.6	9.7	49	504	707	45	215
7	2.2	9.8	74	713	910	78	378
8	1.8	9.6	55	585	1200	49	290
9	2.4	9.7	80	739	225	82	140
13	2.8	9.7	225	947	1800	61	450
14	4.4	6.0	170	1300	7	172	2

Table 3-8-30. Water chemistry data obtained at the Tract Stations during RBOSP Aquatic Baseline Studies, July 1975 - August 1975. Results are expressed in mg/l (unless otherwise noted) and are the means of duplicate analyses.

Station ¹	Parameter					
	Ammonia (N)	Calcium (Ca)	Organic Carbon(C) Dissolved	Total Organic Carbon(C)	Chloride (Cl)	Color (APHA)
7	<0.10	77	8	7	8.0	10-20
8	<0.10	78	8	9	11.0	10-20
9	<0.10	79	11	7	8.0	10-20
13	<0.10	70	9	6	18.0	10-20
14	<0.10	117	12	11	24.0	20-30
15	<0.10	94	10	12	21.0	20-30
17	<0.10	141	9	7	16.0	10-20
18	<0.10	124	15	12	31.0	20-30

¹ Stations 6, 10 - 12, and 16 were dry at the time of sampling.

Table 3-8-30. (Continued)

Station	Parameter						Total Phosphate (P)
	Hardness (CaCO ₃)	Magnesium (Mg)	Nitrate (N)	Nitrite (N)	Kjeldahl Nitrogen (N)	Ortho Phosphate (P)	
7	399	57	1.0	<0.01	0.37	<0.02	0.03
8	409	52	0.7	<0.01	0.36	0.06	0.03
9	405	57	0.8	<0.01	0.55	<0.01	0.02
13	392	56	0.3	<0.01	0.42	0.03	0.05
14	638	106	1.2	0.04	0.68	<0.01	0.04
15	647	106	<0.2	0.02	0.63	<0.01	0.03
17	634	94	0.4	<0.01	0.66	0.05	0.07
18	637	104	0.6	0.03	0.66	<0.01	0.04

Table 3-8 -30. (Continued)

Station	Parameter						
	Potassium (K)	Soluble Silica (Si)	Sodium (Na)	Dissolved Solids	Suspended Solids	Sulfate (S)	Turbidity (JTU)
7	2.0	8.9	92	714	31	87	4
8	1.9	9.0	78	669	6	59	1
9	3.0	9.3	98	750	18	88	4
13	2.4	9.2	112	779	23	82	6
14	5.7	8.1	181	1350	31	190	7
15	5.9	6.0	182	1300	15	191	2
17	6.8	9.3	156	1250	47	168	8
18	6.4	9.1	182	1350	9	190	1

Table 3-8-31. Water chemistry data obtained at the Tract Stations during RBOSP Aquatic Baseline Studies, August 1975 - September 1975. Results are expressed in mg/l (unless otherwise noted) and are the means of duplicate analyses.

Station ¹	Parameter					
	Ammonia (N)	Calcium (Ca)	Organic Carbon(C) Dissolved	Total Organic Carbon(C)	Chloride (Cl)	Color (APHA)
7	<0.10	88	<1	<1	6.7	10-20
8	<0.10	80	<1	<1	11.0	10-20
9	<0.10	82	<1	<1	6.3	10-20
12	<0.10	68	<2	3	12.6	20-30
13	<0.10	79	<1	<1	11.0	10-20
14	<0.10	117	<1	<3	19.0	20-30
17	<0.10	105	5	10	18.0	20-30

¹Stations 10, 11, 15, 16, and 18 were dry at the time of sampling.

Table 3-8-31. (Continued)

Station	Parameter						
	Hardness (CaCO ₃)	Magnesium (Mg)	Nitrate (N)	Nitrite (N)	Kjeldahl Nitrogen (N)	Ortho Phosphate (P)	Total Phosphate (P)
7	434	62	0.4	<0.01	0.40	0.01	0.11
8	411	50	0.2	<0.01	0.22	0.03	0.08
9	415	60	0.3	<0.01	0.40	0.01	0.10
12	419	64	0.4	<0.01	0.68	<0.01	0.35
13	438	59	<0.2	<0.01	0.19	0.04	0.04
14	706	109	0.8	0.04	0.77	<0.01	0.11
17	649	104	<0.2	<0.01	0.85	0.02	0.45

Table 3-8-31. (Continued)

Station	Parameter						
	Potassium (K)	Soluble Silica (Si)	Sodium (Na)	Dissolved Solids	Suspended Solids	Sulfate (S)	Turbidity (JTU)
7	1.5	9.8	88	743	102	85	30
8	1.5	9.5	76	681	2	65	1
9	1.7	9.5	89	731	107	93	40
12	4.3	5.9	98	768	300	95	175
13	1.9	5.2	118	809	<1	86	1
14	3.6	9.3	180	1300	2	172	2
17	5.8	10.0	170	1300	560	155	188

organic carbon were recorded during August - September 1975 and the highest concentrations were observed during May - June 1975.

Dissolved organic carbon concentrations at the Tract stations ranged from less than 1 mg/l during August - September 1975 (Table 3-8-31) to 44 mg/l during May - June 1975 (Table 3-8-29). In general, the lowest overall concentrations of dissolved organic carbon were recorded during August - September 1975; the highest concentrations were observed during April 1975.

The hardness (expressed as CaCO_3) of waters of the tract area ranged from 360 mg/l in April 1975 (Table 3-8-28) to 724 mg/l in December 1974 - January 1975 (Table 3-8-27). Over the one-year period, the hardest waters were generally observed at Station 14. The lowest hardness concentrations were recorded in April 1975 and the greatest concentrations were observed during December 1974 - January 1975 (Figure 3-8-6).

Mean concentrations of magnesium at the Tract stations ranged from 41 mg/l in May - June 1975 (Table 3-8-29) to 111 mg/l in December 1974 - January 1975 (Table 3-8-27). Magnesium concentrations at Station 14 were generally higher than at the other Tract stations. Magnesium concentrations were generally lowest during May - June 1975 and highest during July - August 1975 (Figure 3-8-7).

At the Tract stations, the mean concentrations of nitrate nitrogen ranged from less than 0.2 mg/l in both the July - August and August - September 1975 sampling periods (Tables 3-8-30 and 3-8-31 respectively) to 1.5 mg/l in the May - June 1975 sampling (Table 3-8-29). The lowest nitrate nitrogen concentrations were observed in August - September 1975, whereas the highest concentrations occurred in May - June 1975 (Figure 3-8-8).

Mean concentrations of nitrite nitrogen at the individual Tract stations ranged from less than 0.01 mg/l during several sampling periods to 0.04 mg/l during the July - August and August - September 1975 sampling periods (Tables 3-8-30 and 3-8-31 respectively). Nitrite nitrogen concentrations

were lowest during October - November 1974 and April 1975 and highest during July - August 1975.

Mean concentrations of ammonia nitrogen were less than 0.10 mg/l at all Tract stations during each sampling period.

Mean concentrations of Kjeldahl nitrogen at the Tract stations ranged from 0.13 mg/l in October - November 1974 (Table 3-8-26) to 2.50 mg/l in May - June 1975 (Table 3-8-29). The lowest Kjeldahl nitrogen concentrations were observed in December 1974 - January 1975 and the highest concentrations were recorded in May - June 1975.

At the Tract stations, the concentration of orthophosphate (as P) ranged from less than 0.01 mg/l during several sampling periods to 0.05 mg/l during the July - August 1975 sampling (Table 3-8-30). Orthophosphate concentrations at Station 13 were generally slightly higher than at other Tract stations. Overall, concentrations of orthophosphate were lowest during May - June 1975 and highest during July - August 1975 (Figure 3-8-9).

Concentrations of total phosphate (as P) at the Tract stations ranged from less than 0.01 mg/l in December 1974 - January 1975 (Table 3-8-27) to 2.00 mg/l in April 1975 (Table 3-8-28). Total phosphate concentrations were particularly high at Station 13 during April (Table 3-8-28) and May - June 1975 (Table 3-8-29). In general, total phosphate concentrations varied greatly. Concentrations were lowest during December 1974 - January 1975 and July - August 1975 and highest during May - June 1975 (Figure 3-8-10).

Mean potassium concentrations ranged from 1.5 mg/l during August - September 1975 (Table 3-8-31) to 6.8 mg/l during July - August 1975 (Table 3-8-30). Potassium concentrations were generally higher at Stations 14 and 17 than at the other Tract stations. Concentrations of potassium were generally lowest in May - June 1975 and highest in July - August 1975 (Figure 3-8-11).

Mean sodium concentrations at Tract stations ranged from 19 mg/l in October - November 1974 (Table 3-8-26) to 345 mg/l in April 1975 (Table 3-8-28). Stations 13 through 17 generally recorded higher sodium than the other Tract stations. Sodium concentrations were generally lowest during May - June 1975 and highest during April 1975 (Figure 3-8-13).

Dissolved solids concentrations varied from 504 mg/l during May - June 1975 (Table 3-8-20) to 1,350 mg/l during July - August (Table 3-8-30). Dissolved solids concentrations were generally highest at Stations 14 through 18. Overall, dissolved solids concentrations were lowest during May - June 1975 and highest during July - August 1975 (Figure 3-8-14).

Suspended solids concentrations at the Tract stations ranged from less than 1 mg/l during several sampling periods to 1,850 mg/l in the April 1975 sampling (Table 3-8-28). Suspended solids concentrations were generally lowest during December 1974 - January 1975 and highest during May - June 1975.

Mean sulfate concentrations (as S) ranged from 45 mg/l in May - June 1975 (Table 3-8-29) to 191 mg/l in July - August 1975 (Table 3-8-30). Sulfate concentrations were generally highest at Station 14 during the one-year study period. Sulfate concentrations at the Tract stations were lowest during April and May - June 1975 and highest during July - August 1975 (Figure 3-8-15).

c. Yellow Creek - Data concerning the chemical characteristics of the stations located on lower Yellow Creek are summarized in Tables 3-8-32 through 3-8-37 and in Figures 3-8-4 through 3-8-15.

At the lower Yellow Creek stations, mean calcium concentrations varied from 10 mg/l in July - August 1975 (Table 3-8-36) to 67 mg/l in October - November 1974 (Table 3-8-32). Over the one-year period, Station 19 consistently recorded higher calcium concentrations than the other Yellow Creek stations. Calcium concentrations were generally lowest in July - August 1975 and highest during October - November 1974 (Figure 3-8-4).

Table 3-8-32. Water chemistry data obtained at the Yellow Creek Stations during RBOSP Aquatic Baseline Studies, October 1974 - November 1974. Results are expressed in mg/l (unless otherwise noted) and are the means of duplicate analyses.

Station	Parameter					
	Ammonia (N)	Calcium (Ca)	Organic Carbon(C) Dissolved	Total Organic Carbon(C)	Chloride (Cl)	Color (APHA)
19	<0.10	67	49	55	32.5	0-5
20	<0.10	33	10	80	90.5	0-5
21	<0.10	41	53	75	98.0	0-5
22	<0.10	42	54	75	105.0	0-5

Table 3-3-32. (Continued)

Station	Parameter						
	Hardness (CaCO ₃)	Magnesium (Mg)	Nitrate (N)	Nitrite (N)	Kjeldahl Nitrogen (N)	Ortho Phosphate (P)	Total Phosphate (P)
19	875	173	<0.2	<0.01	0.27	0.02	0.04
20	500	102	1.4	0.01	0.42	<0.01	0.03
21	510	99	1.6	0.01	0.48	<0.01	0.08
22	495	96	1.4	0.01	0.49	<0.01	0.03

Table 3-8 -32. (Continued)

Station	Parameter						
	Potassium (K)	Soluble Silica (Si)	Sodium (Na)	Dissolved Solids	Suspended Solids	Sulfate (S)	Turbidity (JTU)
19	8.5	7.8	400	2050	11	293	3
20	6.4	4.6	640	2100	32	168	12
21	6.4	4.8	640	2050	74	173	25
22	6.5	4.1	650	2100	15	167	10

Table 3-8-33. Water chemistry data obtained at the Yellow Creek Stations during RBOSP Aquatic Baseline Studies, December 1974 - January 1975. Results are expressed in mg/l (unless otherwise noted) and are the means of duplicate analyses.

Station	Parameter					
	Ammonia (N)	Calcium (Ca)	Organic Carbon(C) Dissolved	Total Organic Carbon(C)	Chloride (Cl)	Color (APHA)
19	<0.10	62	71	24	25.0	0-5
20	0.16	41	28	31	127.0	0-5
21	0.16	39	28	35	125.0	0-5
22	0.12	38	28	31	127.0	0-5

Table 3-8-33. (Continued)

Station	Parameter						
	Hardness (CaCO ₃)	Magnesium (Mg)	Nitrate (N)	Nitrite (N)	Kjeldahl Nitrogen (N)	Ortho Phosphate (P)	Total Phosphate (P)
19	919	180	0.2	<0.01	0.29	0.07	0.08
20	476	113	2.3	<0.01	0.58	0.05	0.09
21	480	114	2.5	<0.01	0.51	0.05	0.08
22	507	114	2.3	<0.01	0.52,	0.05	0.08

Table 3-8-33. (Continued)

Station	Parameter						
	Potassium (K)	Soluble Silica (Si)	Sodium (Na)	Dissolved Solids	Suspended Solids	Sulfate (S)	Turbidity (JTU)
19	6.6	8.8	348	2010	7	290	4
20	7.1	7.5	740	2334	72	173	35
21	7.0	7.5	720	2279	63	174	30
22	6.9	7.4	720	1160	60	176	30

Table 3-8.-34. Water chemistry data obtained at the Yellow Creek Stations during RBOSP Aquatic Baseline Studies, April 1975. Results are expressed in mg/l (unless otherwise noted) and are the means of duplicate analyses.

Station	Parameter					
	Ammonia (N)	Calcium (Ca)	Organic Carbon(C) Dissolved	Total Organic Carbon(C)	Chloride (Cl)	Color (APHA)
19	<0.10	56	50	54	26.0	10-20
20	<0.10	14	33	33	105.0	20-30
21	<0.10	16	20	31	110.0	5-10
22	<0.10	18	20	23	110.0	10-20

Table 3-8-34. (Continued)

Station	Parameter						
	Hardness (CaCO ₃)	Magnesium (Mg)	Nitrate (N)	Nitrite (N)	Kjeldahl Nitrogen (N)	Ortho Phosphate (P)	Total Phosphate (P)
19	670	182	0.2	<0.01	0.57	<0.05	0.09
20	590	124	0.7	<0.01	0.67	<0.01	0.14
21	570	129	0.8	<0.01	0.66	<0.01	0.10
22	550	130	1.0	<0.01	0.66	<0.01	0.08

Table 3-8-34. (Continued)

Station	Parameter						
	Potassium (K)	Soluble Silica (Si)	Sodium (Na)	Dissolved Solids	Suspended Solids	Sulfate (S)	Turbidity (JTU)
19	9.1	6.3	380	2000	19	281	19
20	7.4	5.1	740	2400	498	204	81
21	7.6	5.2	730	2450	151	198	68
22	7.4	5.5	720	2400	185	196	69

Table 3-3-35. Water chemistry data obtained at the Yellow Creek Stations during RBCSP Aquatic Baseline Studies, May, 1975 - June, 1975. Results are expressed in mg/l (unless otherwise noted) and are the means of duplicate analyses.

Station	Parameter					
	Ammonia (N)	Calcium (Ca)	Organic Carbon(C) Dissolved	Total Organic Carbon(C)	Chloride (Cl)	Color (APHA)
19	< 0.10	53	42	57	29.0	30-40
20	< 0.10	18	94	94	133.0	20-30
21	< 0.10	18	74	79	135.0	20-30
22	< 0.10	16	73	73	149.0	30-40

Table 3-8 -35. (Continued)

Station	Parameter						
	Hardness (CaCO ₃)	Magnesium (Mg)	Nitrate (N)	Nitrite (N)	Kjeldahl Nitrogen (N)	Ortho Phosphate (P)	Total Phosphate (P)
19	900	53	<0.2	<0.01	0.45	<0.01	0.04
20	490	106	<0.2	<0.01	0.56	<0.01	0.02
21	510	104	<0.2	<0.01	0.54	<0.01	0.02
22	500	106	<0.2	<0.01	0.69	<0.01	0.04

Table 3-8 -35. (Continued)

Station	Parameter						Turbidity (JTU)
	Potassium (K)	Soluble Silica (Si)	Sodium (Na)	Dissolved Solids	Suspended Solids	Sulfate (S)	
19	6.4	5.4	363	2100	14	293	7
20	6.3	0.7	815	2550	23	174	7
21	6.3	0.3	815	2550	15	176	4
22	6.4	0.6	800	2550	23	182	7

Table 3-8-36. Water chemistry data obtained at the Yellow Creek Stations during RBOSP Aquatic Baseline Studies, July 1975 - August 1975. Results are expressed in mg/l (unless otherwise noted) and are the means of duplicate analyses.

Station	Parameter					
	Ammonia (N)	Calcium (Ca)	Organic Carbon(C) Dissolved	Total Organic Carbon(C)	Chloride (Cl)	Color (APHA)
19	<0.10	44	12	7	32.0	30-40
20	<0.10	12	<3	8	125.0	20-30
21	<0.10	12	<4	<3	162.0	30-40
22	<0.10	10	4	<4	148.0	25-35

Table 3-8-36. (Continued)

Station	Parameter						
	Hardness (CaCO ₃)	Magnesium (Mg)	Nitrate (N)	Nitrite (N)	Kjeldahl Nitrogen (N)	Ortho Phosphate (P)	Total Phosphate (P)
19	730	166	<0.2	<0.01	0.54	<0.01	0.05
20	433	101	<0.2	<0.01	0.47	<0.01	0.03
21	454	103	<0.2	<0.01	0.42	<0.01	0.02
22	441	103	<0.2	<0.01	0.55	<0.01	0.05

Table 3-8-36. (Continued)

Station	Parameter						
	Potassium (K)	Soluble Silica (Si)	Sodium (Na)	Dissolved Solids	Suspended Solids	Sulfate (S)	Turbidity (JTU)
19	6.4	2.5	404	1925	18	279	9
20	6.6	0.1	875	2455	16	162	7
21	6.8	0.1	879	2535	12	162	8
22	6.8	0.1	977	2540	31	166	25

Table 3-8-37. Water chemistry data obtained at the Yellow Creek Stations during RBOSP Aquatic Baseline Studies, August 1975 - September 1975. Results are expressed in mg/l (unless otherwise noted) and are the means of duplicate analyses.

Station	Parameter					
	Ammonia (N)	Calcium (Ca)	Organic Carbon(C) Dissolved	Total Organic Carbon(C)	Chloride (Cl)	Color (APHA)
19	<0.10	43	<2	6	30.5	30-40
20	<0.10	13	<1	<1	166.5	25-35
21	<0.10	14	<1	<1	159.5	20-30
22	<0.10	13	<1	<1	160.5	30-40

Table 3-8 -37. (Continued)

Station	Parameter						
	Hardness (CaCO ₃)	Magnesium (Mg)	Nitrate (N)	Nitrite (N)	Kjeldahl Nitrogen (N)	Ortho Phosphate (P)	Total Phosphate (P)
19	761	168	<0.2	0.01	0.64	0.04	0.13
20	425	97	<0.2	0.01	0.68	<0.01	0.05
21	422	98	<0.2	0.01	0.71	<0.01	0.04
22	443	98	<0.2	0.01	0.80	<0.01	0.07

Table 3-8-37. (Continued)

Station	Parameter						
	Potassium (K)	Soluble Silica (Si)	Sodium (Na)	Dissolved Solids	Suspended Solids	Sulfate (S)	Turbidity (JTU)
19	5.8	5.0	385	1900	44	286	23
20	5.0	2.0	875	2500	27	144	28
21	5.1	1.6	890	2500	33	150	25
22	5.5	0.4	905	2600	41 ,	150	38

Chloride concentrations in lower Yellow Creek ranged from 25 mg/l in December 1974 - January 1975 (Table 3-8-33) to 166 mg/l in August - September 1975 (Table 3-8-37). During the one-year study period, chloride concentrations were consistently lower at Station 19 than at other Yellow Creek stations. The lowest chloride concentrations were recorded in October - November 1974 and the highest concentrations occurred in August - September 1975 (Figure 3-8-5).

Total organic carbon concentrations in the lower Yellow Creek stations ranged from less than 1 mg/l in August - September 1975 (Table 3-8-37) to 94 mg/l in May - June 1975 (Table 3-8-35). Total organic carbon concentrations were lowest during August - September 1975 and highest during May - June 1975.

Dissolved organic carbon ranged in concentration from less than 1 mg/l in August - September 1975 (Table 3-8-37) to 94 mg/l in May - June 1975 (Table 3-8-35). Dissolved organic carbon concentrations were lowest during August - September 1975 and highest during May - June 1975.

Hardness (expressed as CaCO_3) at individual Yellow Creek stations varied from 422 mg/l during August - September 1975 (Table 3-8-37) to 919 mg/l during December 1974 - January 1975 (Table 3-8-33). Over the one-year study period of the Yellow Creek stations, the highest hardness concentrations were consistently recorded at Station 19. The hardest waters were observed during May - June 1975 and the lowest hardness concentrations were recorded during July - August and August - September 1975 (Figure 3-8-6).

Mean concentrations of magnesium at the lower Yellow Creek stations ranged from 53 mg/l during May - June 1975 (Table 3-8-35) to 182 mg/l during April 1975 (Table 3-8-34). During the one-year study period, magnesium concentrations were generally higher at Station 19 than at other Yellow Creek stations. Magnesium concentrations were lowest during May - June 1975 and highest during April 1975 (Figure 3-8-7).

In Yellow Creek, the mean concentrations of nitrate nitrogen ranged from less than 0.2 mg/l during several sampling periods to 2.5 mg/l during the December 1974 - January 1975 sampling period (Table 3-8-33). Nitrate concentrations at Station 19 were lower than those at the other Yellow Creek stations. Lowest nitrate nitrogen concentrations were observed between May and September 1975; highest concentrations were recorded in December 1974 - January 1975 (Figure 3-8-8).

Nitrite nitrogen concentrations in Yellow Creek varied from less than 0.01 mg/l during several sampling periods to 0.01 mg/l during the October - November 1974 and August - September 1975 sampling periods. (Tables 3-8-32 and 3-8-37 respectively). Nitrite levels were the lowest between April and July - August 1975 and highest during October - November 1974 and August - September 1975.

Mean concentrations of ammonia nitrogen ranged from less than 0.1 mg/l during several sampling periods to 0.15 mg/l during December 1974 - January 1975 (Table 3-8-33). Ammonia concentrations greater than 0.1 mg/l were recorded only during December 1974 - January 1975.

Concentrations of Kjeldahl nitrogen ranged from 0.27 mg/l in October - November 1974 (table 3-8-32) to 0.80 mg/l in August - September 1975 (Table 3-8-37). Kjeldahl nitrogen concentrations were generally lower at Station 19 than at the other Yellow Creek stations. The lowest Kjeldahl concentrations were recorded during October - November 1974 and the highest concentrations were observed during August - September 1975.

Orthophosphate concentrations (as P) in Yellow Creek ranged from less than 0.01 mg/l during several sampling periods to 0.07 mg/l during December 1974 - January 1975 (Table 3-8-33). The highest orthophosphate concentrations were generally recorded at Station 19. The lowest orthophosphate concentrations were observed in May - June and July - August 1975 and the highest concentrations were recorded in December 1974 - January 1975 (Figure 3-8-9).

Total phosphate concentrations (as P) in Yellow Creek varied from 0.02 mg/l in May - June 1975 (Table 3-8-35) and July - August 1975 (Table 3-8-36) to 0.14 mg/l in April 1975 (Table 3-8-34). In general, the lowest concentrations of total phosphate in Yellow Creek were observed in May - June 1975 and highest concentrations were recorded during April 1975 (Figure 3-8-10).

In Yellow Creek, the potassium concentrations ranged from 5.0 mg/l during August - September 1975 (Table 3-8-37) to 9.1 mg/l during April 1975 (Table 3-8-34). The lowest potassium concentrations were recorded in August - September 1975 and the highest concentrations were observed during April 1975 (Figure 3-8-11).

Soluble silica concentrations (as Si) varied from 0.1 mg/l during July - August 1975 (Table 3-8-36) to 8.8 mg/l during December 1974 - January 1975 (Table 3-8-33). Silica concentrations in Yellow Creek were consistently highest at Station 19. Soluble silica concentrations were lowest in July - August 1975 and highest during December 1974 - January 1975 (Figure 3-8-12).

Sodium concentrations in Yellow Creek were quite high throughout the one year of study. Concentrations of sodium varied from 348 mg/l during December 1974 - January 1975 (Table 3-8-33) to 977 mg/l during July - August 1975 (Table 3-8-36). Sodium concentrations in Yellow Creek were consistently lowest at Station 19. The lowest sodium concentrations were observed in October - November 1974 and the highest concentrations were recorded during July - August 1975 (Figure 3-8-13).

In Yellow Creek, dissolved solids concentrations ranged from 1,160 mg/l in December 1974 - January 1975 (Table 3-8-33) to 2,600 mg/l in August - September 1975 (Table 3-8-37). Between April and August - September 1975 dissolved solids concentrations were lowest at Station 19. The lowest dissolved solids concentrations were recorded during October - November 1974 and the highest dissolved solids concentrations were observed during August - September 1974 (Figure 3-8-14).

Suspended solids concentrations in Yellow Creek ranged from 7 mg/l during December 1974 - January 1975 (Table 3-8-33) to 2,600 mg/l in August - September 1975 (table 3-8-37). Between April and August - September 1975 dissolved solids concentrations were lowest at Station 19. The lowest dissolved solids concentrations were recorded during October - November 1974 and the highest dissolved solids concentrations were observed during August - September 1975; the highest concentrations were recorded in April 1975 (Figure 3-8-15).

d. White River - A summary of the data concerning the chemical characteristics of the White River sampling sites is included in Tables 3-8-38 through 3-8-43 and in Figure 3-8-4 through 3-8-15.

At the White River stations, mean calcium concentrations ranged from 36 mg/l in May - June 1975 (Table 3-8-41) to 90 mg/l in December 1974 - January 1975 (Table 3-8-39). The lowest calcium concentrations were observed during May - June 1975 and the highest concentrations were observed during December 1974 - January 1975 (Figure 3-8-4). Chloride concentrations in the White River varied from 8 mg/l during May - June 1975 (Table 3-8-41) to 58 mg/l during July - August 1975 (Table 3-8-42). Chloride concentrations in the White River were lowest in May - June 1975 and highest in December 1974 - January 1975 (Figure 3-8-5).

Total organic carbon concentrations in the White River ranged from less than 1 mg/l during August - September 1975 (Table 3-8-43) to 18 mg/l in October - November 1974 (Table 3-8-38). The lowest dissolved organic carbon concentrations were recorded during August - September 1975 whereas the highest dissolved organic carbon concentrations were observed during October - November 1974.

Hardness (as CaCO_3) at the White River stations ranged from 140 mg/l during May - June 1975 (Table 3-8-41) to 340 mg/l during the same period. Minimum water hardness was recorded during May - June 1975 and maximum hardness was observed during December 1974 - January 1975 (Figure 3-8-6).

Table 3-8-38. Water chemistry data obtained at the White River Stations during RBOSP Aquatic Baseline Studies, October 1974 - November 1974. Results are expressed in mg/l (unless otherwise noted) and are the means of duplicate analyses.

Station	Parameter					
	Ammonia (N)	Calcium (Ca)	Organic Carbon(C) Dissolved	Total Organic Carbon(C)	Chloride (Cl)	Color (APHA)
Above Confluence with Yellow Creek						
23	<0.10	72	17	13	33.5	0-5
24	<0.10	74	15	13	30.0	0-5
25	<0.10	72	14	13	32.0	0-5
26	<0.10	71	15	13	31.5	0-5
27	<0.10	73	16	12	30.5	0-5
At Confluence with Yellow Creek						
28	<0.10	72	15	15	31.5	0-5
29	<0.10	71	18	13	33.0	0-5
Below Confluence with Yellow Creek						
30	<0.10	69	15	12	32.5	0-5
31	<0.10	70	17	13	31.5	0-5
32	<0.10	72	17	14	32.0	0-5
33	<0.10	70	16	13	32.0	0-5
34	<0.10	73	14	15	33.0	0-5
35	<0.10	72	16	17	35.5	0-5

Table 3-8 -38. (Continued)

Station	Parameter						Total Phosphate (P)
	Hardness (CaCO ₃)	Magnesium (Mg)	Nitrate (N)	Nitrite (N)	Kjeldahl Nitrogen (N)	Ortho Phosphate (P)	
Above Confluence with Yellow Creek							
23	285	25	<0.2	<0.01	0.18	<0.01	0.04
24	275	22	<0.2	<0.01	0.10	<0.01	0.03
25	270	22	<0.2	<0.01	0.10	<0.01	0.04
26	270	22	<0.2	<0.01	0.14	<0.01	0.03
27	272	22	<0.2	<0.01	0.10	<0.01	0.03
At Confluence with Yellow Creek							
28	270	22	<0.2	<0.01	0.10	0.01	0.02
29	280	25	<0.2	<0.01	0.18	<0.01	0.03
Below Confluence with Yellow Creek							
30	260	22	<0.2	<0.01	0.13	<0.01	0.04
31	265	22	<0.2	<0.01	0.11	<0.01	0.03
32	275	23	<0.2	<0.01	0.14	<0.01	0.02
33	270	23	<0.2	<0.01	0.10	<0.01	0.02
34	275	23	<0.2	<0.01	0.11	<0.01	0.03
35	270	23	<0.2	<0.01	0.32	<0.01	0.03

Table 3-8-33. (Continued)

Station	Parameter						
	Potassium (K)	Soluble Silica (Si)	Sodium (Na)	Dissolved Solids	Suspended Solids	Sulfate (S)	Turbidity (JTU)
Above Confluence with Yellow Creek							
23	2.5	2.4	64	476	20	52	10
24	2.4	5.7	60	456	18	50	8
25	2.4	5.7	60	455	20	52	7
26	2.4	5.6	60	461	22	50	8
27	2.5	5.5	60	466	22	51	7
At Confluence with Yellow Creek							
28	2.3	5.9	60	461	18	51	7
29	2.7	5.6	87	468	24	52	8
Below Confluence with Yellow Creek							
30	2.5	5.6	60	451	21	51	9
31	2.5	5.5	60	464	25	50	10
32	2.5	5.4	69	492	23	51	10
33	2.5	5.3	64	481	17	50	8
34	2.5	5.5	64	473	21	51	9
35	2.5	5.3	64	492	17	50	8

Table 3-8-39. Water chemistry data obtained at the White River Stations during RRNSP Aquatic Baseline Studies, December 1974 - January 1975. Results are expressed in mg/l (unless otherwise noted) and are the means of duplicate analyses.

Station	Parameter					
	Ammonia (N)	Calcium (Ca)	Organic Carbon(C) Dissolved	Total Organic Carbon(C)	Chloride (Cl)	Color (APHA)
Above Confluence with Yellow Creek						
23	<0.10	83	6	6	43.0	0-5
24	<0.10	77	6	5	44.0	0-5
25	<0.10	75	7	6	37.0	0-5
26	<0.10	76	6	6	36.0	0-5
27	<0.10	83	9	7	38.0	0-5
At Confluence with Yellow Creek						
28	<0.10	86	7	8	38.0	0-5
29	<0.10	79	8	8	44.0	0-5
Below Confluence with Yellow Creek						
30	<0.10	77	8	6	36.0	0-5
31	<0.10	77	8	6	37.0	0-5
32	<0.10	87	6	6	39.0	0-5
33	<0.11	79	6	6	42.0	0-5
34	<0.10	90	6	6	42.0	0-5
35	<0.10	83	6	5	43.0	0-5

Table 3-8-39. (Continued)

Station	Parameter						
	Hardness (CaCO ₃)	Magnesium (Mg)	Nitrate (N)	Nitrite (N)	Kjeldahl Nitrogen (N)	Ortho Phosphate (P)	Total Phosphate (P)
Above Confluence with Yellow Creek							
23	319	36	1.0	<0.01	0.31	0.01	0.08
24	301	27	0.5	<0.01	0.33	<0.01	0.09
25	289	27	0.5	<0.01	0.65	0.01	0.11
26	286	27	0.7	<0.01	0.51	<0.01	0.11
27	292	29	<0.2	<0.01	0.28	0.01	0.08
At Confluence with Yellow Creek							
28	293	30	<0.2	<0.01	0.20	0.01	0.07
29	289	37	0.9	<0.01	0.26	0.02	0.07
Below Confluence with Yellow Creek							
30	297	28	<0.2	<0.01	0.17	<0.01	0.04
31	281	28	<0.2	<0.01	0.26	0.02	0.04
32	287	30	1.0	<0.01	0.26	0.01	0.04
33	299	29	0.4	<0.01	0.14	<0.01	0.03
34	319	35	1.0	<0.01	0.65	0.02	0.20
35	316	32	0.9	<0.01	0.54	0.02	0.13

Table 3-8 -39. (Continued)

Station	Parameter						
	Potassium (K)	Soluble Silica (Si)	Sodium (Na)	Dissolved Solids	Suspended Solids	Sulfate (S)	Turbidity (JTU)
Above Confluence with Yellow Creek							
23	3.3	8.1	81	605	93	63	40
24	3.2	7.5	64	480	82	52	40
25	3.1	7.6	64	475	160	52	40
26	3.1	7.6	62	486	125	50	40
27	3.0	7.7	75	533	85	59	30
At Confluence with Yellow Creek							
28	3.2	7.2	69	544	89	60	35
29	3.4	7.5	130	687	77	69	30
Below Confluence with Yellow Creek							
30	2.7	7.2	54	522	36	56	20
31	2.7	7.1	71	537	35	57	20
32	3.1	7.2	79	560	22	61	10
33	2.6	7.8	71	574	12	60	10
34	4.0	8.1	79	601	208	62	60
35	3.5	8.4	77	618	125	62	45

Table 3-8-40. Water chemistry data obtained at the White River Stations during RBOSP Aquatic Baseline Studies, April 1975. Results are expressed in mg/l (unless otherwise noted) and are the means of duplicate analyses.

Station	Parameter					
	Ammonia (N)	Calcium (Ca)	Organic Carbon(C) Dissolved	Total Organic Carbon(C)	Chloride (Cl)	Color (APHA)
Above Confluence with Yellow Creek						
23	<0.10	65	5	8	25.0	10-20
24	<0.10	64	6	9	27.0	20-30
25	<0.10	66	4	12	28.0	20-30
26	<0.10	65	6	10	28.0	15-30
27	<0.10	68	3	4	33.0	10-20
At Confluence with Yellow Creek						
28	<0.10	68	3	6	33.0	10-20
29	<0.10	58	5	7	39.0	5-10
Below Confluence with Yellow Creek						
30	<0.10	66	3	7	31.0	5-10
31	<0.10	66	13	20	30.0	20-30
32	<0.10	64	16	21	31.0	20-30
33	<0.10	62	17	18	27.0	10-20
34	<0.10	61	17	21	28.0	10-20
35	<0.10	60	14	20	27.0	15-25

Table 3-S-40. (Continued)

Station	Parameter						
	Hardness (CaCO ₃)	Magnesium (Mg)	Nitrate (N)	Nitrite (N)	Kjeldahl Nitrogen (N)	Ortho Phosphate (P)	Total Phosphate (P)
Above Confluence with Yellow Creek							
23	280	22	<0.2	<0.01	0.94	<0.02	0.25
24	290	24	<0.2	<0.01	0.80	<0.01	0.31
25	280	24	<0.2	<0.01	0.77	<0.01	0.28
26	280	24	<0.2	<0.01	0.68	<0.01	0.28
27	290	26	<0.2	<0.01	0.41	<0.01	0.09
At Confluence with Yellow Creek							
28	280	26	<0.2	<0.01	0.38	<0.01	0.12
29	280	32	<0.2	<0.01	0.44	<0.01	0.09
Below Confluence with Yellow Creek							
30	290	26	<0.2	<0.01	0.81	<0.01	0.22
31	290	26	<0.2	<0.01	0.68	<0.01	0.21
32	290	28	<0.2	<0.01	0.63	<0.01	0.16
33	280	22	<0.2	<0.01	0.58	<0.01	0.19
34	280	22	<0.2	<0.01	0.52	<0.01	0.18
35	270	22	<0.2	<0.01	1.20	<0.01	0.20

Table 3-3 -40. (Continued)

Station	Parameter						
	Potassium (K)	Soluble Silica (Si)	Sodium (Na)	Dissolved Solids	Suspended Solids	Sulfate (S)	Turbidity (JTU)
Above Confluence with Yellow Creek							
23	2.5	6.3	48	454	204	49	65
24	2.7	6.1	60	480	311	56	90
25	2.7	6.1	59	476	315	55	93
26	2.7	6.0	58	496	321	55	95
27	2.8	5.8	69	530	124	61	44
At Confluence with Yellow Creek							
28	2.8	5.7	68	524	148	61	47
29	3.2	5.8	113	636	126	71	53
Below Confluence with Yellow Creek							
30	2.8	5.8	63	515	303	60	92
31	2.8	5.9	66	514	286	59	89
32	2.9	5.8	77	544	341	63	98
33	2.6	6.2	58	475	264	52	70
34	2.6	6.2	58	467	283	53	70
35	2.6	6.2	57	471	226	53	66

Table 3-8-41. Water chemistry data obtained at the White River Stations during RBOSP Aquatic Baseline Studies, May 1975 - June 1975. Results are expressed in mg/l (unless otherwise noted) and are the means of duplicate analyses.

Station	Parameter					
	Ammonia (N)	Calcium (Ca)	Organic Carbon(C) Dissolved	Total Organic Carbon(C)	Chloride (Cl)	Color (APHA)
Above Confluence with Yellow Creek						
23	<0.10	38	6	11	8	30-40
24	<0.10	42	10	9	13	30-40
25	<0.10	40	8	9	10	30-40
26	<0.10	41	12	13	8	30-40
27	<0.10	39	7	10	8	30-40
At Confluence with Yellow Creek						
28	<0.10	36	9	12	13	20-30
29	<0.10	36	6	10	8	20-30
Below Confluence with Yellow Creek						
30	<0.10	41	11	12	9	30-40
31	<0.10	39	11	10	8	30-40
32	<0.10	39	12	12	9	30-40
33	<0.10	40	6	10	12	30-40
34	<0.10	38	9	12	10	30-40
35	<0.10	40	6	10	9	20-30

Table 3-8-41. (Continued)

Station	Parameter						
	Hardness (CaCO ₃)	Magnesium (Mg)	Nitrate (N)	Nitrite (N)	Kjeldahl Nitrogen (N)	Ortho Phosphate (P)	Total Phosphate (P)
Above Confluence with Yellow Creek							
23	160	10	<0.2	<0.01	0.37	0.02	0.15
24	340	13	<0.2	<0.01	0.36	0.02	0.10
25	150	11	<0.2	<0.01	0.33	0.02	0.07
26	170	12	<0.2	<0.01	0.55	0.03	0.18
27	180	10	<0.2	<0.01	0.55	0.02	0.26
At Confluence with Yellow Creek							
28	160	14	<0.2	<0.01	0.75	<0.01	0.28
29	140	10	<0.2	<0.01	0.45	0.02	0.20
Below Confluence with Yellow Creek							
30	195	12	<0.2	<0.01	0.44	0.02	0.14
31	180	12	<0.2	<0.01	0.51	0.03	0.16
32	190	12	<0.2	<0.01	0.37	0.02	0.13
33	150	11	<0.2	<0.01	0.58	0.03	0.24
34	145	11	<0.2	<0.01	0.64	0.02	0.05
35	150	11	<0.2	<0.01	0.41	0.02	0.20

Table 3-3-41. (Continued)

Station	Parameter						
	Potassium (K)	Soluble Silica (Si)	Sodium (Na)	Dissolved Solids	Suspended Solids	Sulfate (S)	Turbidity (JTU)
Above Confluence with Yellow Creek							
23	1.5	5.2	14	217	118	15	44
24	1.7	5.6	19	224	46	19	30
25	1.5	5.3	16	228	97	16	30
26	1.6	5.3	16	234	143	19	49
27	1.4	4.8	13	200	321	13	64
At Confluence with Yellow Creek							
28	1.7	4.7	46	254	146	22	47
29	1.4	4.8	17	208	161	14	48
Below Confluence with Yellow Creek							
30	1.6	5.6	16	224	105	18	41
31	1.5	5.5	15	232	152	17	41
32	1.6	5.4	22	261	95	20	37
33	1.5	5.2	16	211	280	16	63
34	1.5	5.1	14	243	205	16	57
35	1.5	5.2	15	212	197	16	52

Table 3-3-42. Water chemistry data obtained at the White River Stations during RBOSP Aquatic Baseline Studies, July 1975 - August 1975. Results are expressed in mg/l (unless otherwise noted) and are the means of duplicate analyses.

Station	Parameter					
	Ammonia (N)	Calcium (Ca)	Organic Carbon(C) Dissolved	Total Organic Carbon(C)	Chloride (Cl)	Color (APHA)
Above Confluence with Yellow Creek						
23	0.12	64	3	3	25.0	20-30
24	<0.10	61	3	4	58.0	15-25
25	<0.10	62	3	3	23.0	10-20
26	0.21	68	3	3	22.0	10-20
27	<0.10	61	9	9	23.0	15-25
At Confluence with Yellow Creek						
28	<0.10	64	9	9	23.0	15-25
29	<0.10	62	8	9	22.0	10-20
Below Confluence with Yellow Creek						
30	< 0.10	63	10	9	23.0	10-20
31	< 0.10	60	9	12	23.0	10-20
32	< 0.10	61	9	9	23.0	10-20
33	< 0.10	63	10	10	22.0	8-15
34	< 0.10	65	10	10	22.0	10-20
35	< 0.10	64	11	10	22.0	10-20

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Table 3-8-42. (Continued)

Station	Parameter						
	Hardness (CaCO ₃)	Magnesium (Mg)	Nitrate (N)	Nitrite (N)	Kjeldahl Nitrogen (N)	Ortho Phosphate (P)	Total Phosphate (P)
Above Confluence with Yellow Creek							
23	248	23	<0.2	<0.01	0.41	0.02	0.06
24	235	21	<0.2	<0.01	0.44	0.02	0.08
25	240	21	<0.2	<0.01	0.65	0.02	0.07
26	240	20	<0.2	<0.01	0.33	0.02	0.07
27	248	20	<0.2	<0.01	0.39	0.02	0.08
At Confluence with Yellow Creek							
28	254	22	<0.2	<0.01	0.39	0.03	0.06
29	248	21	<0.2	<0.01	0.43	0.04	0.09
Below Confluence with Yellow Creek							
30	244	20	<0.2	<0.01	0.28	0.03	0.06
31	242	20	<0.2	<0.01	0.31	0.03	0.08
32	242	22	<0.2	<0.01	0.19	0.03	0.07
33	244	22	<0.2	<0.01	0.16	0.04	0.05
34	246	22	<0.2	<0.01	0.25	0.02	0.04
35	242	22	<0.2	<0.01	0.22	0.02	0.04

Table 3-8 -42. (Continued)

Station	Parameter						
	Potassium (K)	Soluble Silica (Si)	Sodium (Na)	Dissolved Solids	Suspended Solids	Sulfate (S)	Turbidity (JTU)
Above Confluence with Yellow Creek							
23	2.5	3.8	50	409	63	41	20
24	2.3	3.8	50	370	44	37	15
25	2.4	4.0	50	372	49	38	20
26	2.4	4.7	49	366	51	38	15
27	2.2	4.2	41	402	73	39	28
At Confluence with Yellow Creek							
28	2.4	5.0	45	411	51	42	20
29	2.2	4.9	41	395	143	40	33
Below Confluence with Yellow Creek							
30	2.2	4.3	40	384	42	39	18
31	2.2	4.4	42	388	35	38	18
32	2.2	4.6	50	403	44	40	20
33	2.2	4.3	43	384	23	39	13
34	2.2	4.4	43	383	22	40	10
35	2.3	4.6	43	383	25	40	15

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Table 3-8 -43. Water chemistry data obtained at the White River Stations during RBOSP Aquatic Baseline Studies, August 1975 - September 1975. Results are expressed in mg/l (unless otherwise noted) and are the means of duplicate analyses.

Station	Parameter					
	Ammonia (N)	Calcium (Ca)	Organic Carbon(C) Dissolved	Total Organic Carbon(C)	Chloride (Cl)	Color (APHA)
Above Confluence with Yellow Creek						
23	<0.10	77	2	1	34.0	20-30
24	<0.10	68	2	<1	36.5	20-30
25	<0.10	71	2	1	30.5	20-30
26	<0.10	68	1	4	30.5	20-30
27	<0.10	68	1	1	29.5	20-30
At Confluence with Yellow Creek						
28	<0.10	66	<1	<1	38.5	15-25
29	<0.10	67	<2	1	30.5	10-20
Below Confluence with Yellow Creek						
30	<0.10	65	1	<1	30.0	10-20
31	<0.10	68	<1	2	30.5	10-20
32	<0.10	67	2	1	31.0	10-20
33	<0.10	74	2	<1	38.5	10-20
34	<0.10	73	<1	<1	34.5	20-30
35	<0.10	70	2	<1	33.0	10-20

Table 3-3 -43. (Continued)

Station	Parameter						
	Hardness (CaCO ₃)	Magnesium (Mg)	Nitrate (N)	Nitrite (N)	Kjeldahl Nitrogen (N)	Ortho Phosphate (P)	Total Phosphate (P)
Above Confluence with Yellow Creek							
23	291	33	<0.2	<0.01	0.35	<0.01	0.06
24	282	29	<0.2	<0.01	0.28	<0.01	0.06
25	274	31	<0.2	<0.01	0.32	<0.01	0.05
26	271	30	<0.2	<0.01	0.33	<0.01	0.05
27	279	30	<0.2	<0.01	0.21	<0.01	0.04
At Confluence with Yellow Creek							
28	270	35	<0.2	<0.01	0.21	<0.01	0.04
29	272	31	<0.2	<0.01	0.15	<0.01	0.04
Below Confluence with Yellow Creek							
30	270	30	<0.2	<0.01	0.37	<0.01	0.04
31	271	31	<0.2	<0.01	0.32	<0.01	0.04
32	271	31	<0.2	<0.01	0.35	<0.01	0.04
33	293	33	<0.2	<0.01	0.31	<0.01	0.03
34	293	33	<0.2	<0.01	0.30	<0.01	0.04
35	289	33	<0.2	<0.01	0.25	<0.01	0.03

Table 3-8'-43. (Continued)

Station	Parameter						
	Potassium (K)	Soluble Silica (Si)	Sodium (Na)	Dissolved Solids	Suspended Solids	Sulfate (S)	Turbidity (JTU)
Above Confluence with Yellow Creek							
23	2.6	6.6	71	543	41	55	15
24	2.4	6.3	62	490	37	49	15
25	2.6	6.2	58	796	34	51	15
26	2.5	6.2	59	499	32	48	13
27	2.4	6.1	61	507	19	50	10
At Confluence with Yellow Creek							
28	2.6	6.0	88	542	104	56	28
29	2.4	6.1	74	528	48	52	15
Below Confluence with Yellow Creek							
30	2.5	6.1	59	489	36	52	13
31	2.4	6.1	60	486	31	52	13
32	2.4	6.1	67	502	27	51	17
33	2.5	5.8	70	534	21	56	10
34	2.8	5.8	70	773	26	58	15
35	2.6	5.8	70	538	20	57	10

Mean concentrations of magnesium in the White River ranged from 10 mg/l during May - June 1975 (Table 3-8-41) to 37 mg/l during December 1974 - January 1975 (Table 3-8-39). The lowest magnesium concentrations were recorded during May - June 1975, and the highest concentrations were observed during August - September 1975 (Figure 3-8-7).

In the White River, the mean concentrations of nitrate nitrogen ranged from less than 0.2 mg/l during several sampling periods to 1.0 mg/l during December 1974 - January 1975 (Table 3-8-39). Nitrate concentrations did not generally vary greatly through the one year study; however, maximum nitrate concentrations were recorded during December 1974 - January 1975 (Figure 3-8-8).

Nitrite nitrogen concentrations were always less than 0.01 mg/l in the White River study area.

The mean concentration of ammonia nitrogen varied from less than 0.01 mg/l during most sampling periods to 0.21 mg/l during July - August 1975 (Table 3-8-42). Ammonia concentrations were greater than the minimum detectable levels only in July - August 1975.

Kjeldahl nitrogen concentrations in the White River ranged from 0.10 mg/l during October - November 1974 (Table 3-8-38) to 1.20 mg/l during April 1975 (Table 3-8-40). Minimum Kjeldahl nitrogen levels were observed during October - November 1974 and maximum levels were recorded in April 1975.

Orthophosphate concentrations (as P) in the White River ranged from less than 0.01 mg/l during several sampling periods to 0.04 mg/l in July - August 1975 (Table 3-8-42). Minimum orthophosphate levels were recorded during several periods; maximum concentrations were observed in July - August 1975 (Figure 3-8-9).

Total phosphate concentrations (as P) in the White River ranged from 0.02 mg/l in October - November 1974 (Table 3-8-38) to 0.31 mg/l in April 1975 (Table 3-8-40). The lowest total phosphate concentrations were recorded during October - November 1974 and August - September 1975, and the highest were recorded during April 1975 (Figure 3-8-10).

In the White River, mean potassium concentrations ranged from 1.4 mg/l in May - June 1975 (Table 3-8-41) to 4.0 mg/l in December 1974 - January 1975 (Table 3-8-39). Potassium concentrations in the White River were lowest in May - June 1975 and highest in December 1974 - January 1975 (Figure 3-8-11).

Soluble silica concentrations (as Si) in the White River varied from 2.4 mg/l in October - November 1974 (Table 3-8-38) to 8.4 mg/l in December 1974 - January 1975 (Table 3-8-39). The lowest silica concentrations in the White River were recorded during July - August 1975 and the highest concentrations were observed during December 1974 - January 1975 (Figure 3-8-12).

In the White River, sodium concentrations ranged from 13 mg/l during May - June 1975 (Table 3-8-41) to 130 mg/l during December 1974 - January 1975 (Table 3-8-39). Sodium concentrations were generally slightly higher at the confluence of the White River and Yellow Creek than at the other White River areas. The lowest sodium concentrations in the White River were recorded in May - June 1975 and the highest concentrations were reported in December 1974 - January 1975 (Figure 3-8-13).

In the White River, dissolved solids concentrations ranged from 200 mg/l in May - June 1975 (Table 3-8-41) to 618 mg/l in December 1974 - January 1975 (Figure 3-8-13).

Suspended solids concentrations ranged from 12 mg/l in December 1974 - January 1975 (Table 3-8-39) to 341 mg/l in April 1975 (Table 3-8-40).

Sulfate concentrations were lowest during May - June 1975 and highest during December 1974 - January 1975 (Figure 3-8-15).

5. Discussion - The waters studied in RBOSP Aquatic Baseline Studies range in hardness from hard (150 to 300 mg/l CaCO_3) to very hard (above 300 mg/l CaCO_3), according to the classification of Sawyer and McCarty (1967). Calcium and magnesium, the alkaline earth cations primarily responsible for hardness in most waters, were present in relatively high concentrations in all waters studied in the RBOSP Aquatic Baseline Studies. However, calcium and magnesium carbonates did not account for all of the hardness. According to Brown et al. (1970), the fraction of hardness which is equivalent to the alkalinity is the carbonate hardness, while any excess is non-carbonate hardness; the non-carbonate hardness is due to the salts of alkaline earth metals other than carbonates and bicarbonates. In the present study area, waters generally contained both carbonate and non-carbonate hardness.

Pennak (1974) observed that, in many streams of the Piceance Creek Basin, magnesium is more abundant than calcium, a reverse of the situation expected in most streams. This phenomenon was observed only in Yellow Creek during the current RBOSP studies. Seasonal variations in the concentrations of calcium, magnesium, and hardness were particularly evident during the spring when high flows resulted in dilution of calcium, magnesium, and hardness concentrations, except in lower Yellow Creek. The hardest water in the study area occurred in Yellow Creek and, in particular at Station 19, a pond fed by a saline spring. The ranges of calcium and magnesium concentrations observed in the White River and Yellow Creek during RBOSP Aquatic Baseline Studies were similar to that observed by Everhart and May (1973). The higher concentrations of calcium which were reported by Pennak (1974) for Yellow Creek and the White River can probably be attributed to differences in analytical methodology.

Chloride concentrations were higher in Yellow Creek than in other waters during the initial year of aquatic studies, and were somewhat higher in the White River than in either the headwater or tract areas. Seasonal variations in chloride concentrations were most noticeable in Yellow Creek and especially in the White River, as the chloride concentrations decreased during the period of high spring flows. The 170 mg/l of chloride suggested by Hart et al. (1945, cited in McKee and Wolf, 1963) as the limit below which freshwater fish do well, was approached or exceeded only in Yellow Creek. The fact that chloride concentrations in the White River were generally higher than in either the tract or headwater areas probably results from the inflow of a number of saline streams as well as from irrigation return and groundwater. Pennak (1974) noted that the inflow of the saline waters of Piceance Creek produced marked changes in the salinity of the White River. The ranges of chloride concentrations in the White River and Yellow Creek during RBOSP Aquatic Baseline Studies were generally similar to those reported by Everhart and May (1973) and Pennak (1974), although the chloride concentrations in Yellow Creek were lower during the present studies than reported previously. This is probably due to the inclusion of Station 19 in the RBOSP studies; Everhart and May and Pennak did not study Station 19. Chloride concentrations were generally lower at Station 19 than at the other Yellow Creek stations.

Sodium concentrations were very high in Yellow Creek and were higher there than in any of the other waters sampled. Sodium concentrations were generally somewhat higher at Stations 28 and 29 in the White River at its confluence with Yellow Creek suggesting at least a localized effect on the salinity of the White River (Figure 3-8-13). Sodium concentrations in Yellow Creek always fell within the 500-1,000 mg/l range reported by McKee and Wolf (1963) as the threshold for toxicity to fish. In Yellow Creek, the range of sodium concentrations observed during RBOSP Aquatic Studies was between those reported by Everhart and May (1973) and Pennak (1974), whereas the range of sodium concentrations observed in the White River during the present studies was slightly greater than that observed during earlier investigations.

The concentration of sulfate was relatively high in all waters, but it was much higher in Yellow Creek than in any other area. Seasonal variations in sulfate concentrations were particularly noticeable in the Headwater and in the White River, where increased flows during the spring produced a dilution of sulfate concentrations. The inflow of high sulfate concentrations from Yellow Creek produced slightly higher sulfate concentrations in the White River at and below the confluence (Figure 3-8-15). The ranges of sulfate concentrations (expressed as sulfur) recorded in Yellow Creek and the White River during RBOSP Aquatic Studies were generally similar to those (expressed as sulfate) reported by Everhart and May (1973) and Pennak (1974).

The concentrations of dissolved solids was generally high (greater than 400 mg/l) in all waters of the study area, and was particularly high in Yellow Creek (greater than 2,000 mg/l). Specific conductance and dissolved solids concentrations were greatest in Yellow Creek and lowest in the White River and appeared to be related to each other in a manner similar to that suggested by Hem (1959). The major contributors to dissolved solids (carbonates, sulfates, and chlorides) were all found in highest concentrations in Yellow Creek and in lowest concentrations in the White River. Pennak (1974) noted that streams of the Piceance Basin carry large quantities of dissolved salts and are thus considerably different chemically from typical granitic Colorado mountain streams.

Suspended solids concentrations were generally highest at the Tract stations and lowest in the Headwaters. In most of the study area, suspended solids concentrations were highest during the spring runoff.

The quantity of organic carbon (both total and dissolved) was somewhat higher at the tract and Yellow Creek sites than in the headwaters or

White River; probably because of greater inflow of allochthonous organic matter. (At times, the quantity of dissolved organic carbon was higher than that of total organic carbon. The reason for this is unclear.)

Nitrate and Kjeldahl nitrogen were the most abundant forms of nitrogen found in waters of the study area. Both forms of nitrogen were generally found in higher concentrations in the tract and headwater regions than elsewhere, although the highest nitrate concentrations were recorded in Yellow Creek during the winter of 1974. Hynes (1970) noted that nitrate levels in streams have never been documented as being limiting for plant growth. This appears to be the case in the streams considered in the present studies.

The concentrations of orthophosphate and total phosphate varied considerably among sampling locations and sampling periods. Both constituents were generally present in low concentrations, although the concentrations of orthophosphate were generally higher than the 0.015 mg/l suggested by the Federal Water Pollution Control Administration (1968) as limiting to the growth of algae.

Potassium occurred in considerably higher concentrations in Yellow Creek than elsewhere, but the potassium concentrations in Yellow Creek were well below the 50 to 300 mg/l toxicity threshold suggested by McKee and Wolf (1963). The concentrations of potassium in all waters considered in the present studies were higher than those which could be considered limiting for algal growth.

Silica concentrations were generally highest in waters of the headwater and tract areas and lowest in Yellow Creek. Silica levels were generally highest in the winter sampling and were high enough so as not to limit the growth of diatoms in any of the waters being studied.

In summary, waters included in the RBOSP aquatic baseline studies ranged from hard to very hard, with high calcium and magnesium concentrations in all waters. The hardest waters in the study area occurred in Yellow Creek. Yellow Creek also contained higher chloride, sodium, sulfate, dissolved solids, nitrate and potassium concentrations than the headwater, tract or White River study areas. The inflow of saline Yellow Creek waters to the White River produced slightly higher concentrations of sodium, sulfate, and dissolved solids in the area of the confluence than in other areas of the White River. Sodium concentrations in Yellow Creek consistently fell within the range reported as the threshold for toxicity to fish. While the concentration of dissolved solids was generally high (greater than 400 mg/l) in all waters of the study area, it was particularly high (greater than 2000 mg/l) in Yellow Creek. Suspended solids concentrations were generally highest at the tract stations and lowest at the headwaters. The quantity of organic carbon (both total and dissolved) was somewhat higher at the tract and Yellow Creek sites, most likely due to a greater inflow of allochthonous organic matter. Nitrate and Kjeldahl nitrogen were the most abundant forms of nitrogen found in the study area and the concentrations of orthophosphate, total phosphate, potassium, and silica were all higher than those considered limiting for algal growth.

C. Sediment Studies

1. Objectives - The objective of this aspect of the Aquatic Baseline Studies is to determine certain characteristics of stream sediments to provide a measure of ambient (i.e., pre-development) conditions for comparison with conditions after tract development is initiated.

2. Methods - When possible, duplicate samples were collected at each sampling station. Chemical determinations included the following parameters: aluminum, arsenic, lead, mercury, Kjeldahl nitrogen, total phosphate, volatile solids, zinc, and the herbicides Tordon 22K and Silvex.

Analytical methods used are those outlined by EPA (1969, 1973), except that colorimetry was used for the determination of arsenic. Analytical methods and detection limits are outlined in Table 3-8-18. The indicated detection limits are considered to be nominal values; the actual minimum levels detected vary with sample size and type (size of clay fraction, type of clay material, etc.). Samples for pesticide analysis are collected in glass jars and are refrigerated for preservation. Samples for the other sediment analyses are placed in plastic bottles and frozen to preserve the sample.

In addition to these chemical analyses, stream substrates were visually categorized (cobble, stone, gravel, sand, silt, clay, detritus, vegetation) during field surveys.

3. Literature Review - No site-specific literature on sediment chemistry characteristics is available. The literature reviewed is concerned with observed characteristics in other rivers and streams to provide some basis for comparison and evaluation of levels observed on and near Tract C-a.

Konrad (1972) presents the results of a survey of sediment mercury in 27 Wisconsin rivers and streams, some of which were in areas subject to industrial and municipal waste discharges. Natural background levels ranged from less than 0.01 to 0.05 $\mu\text{g/g}$ (ppm) in sandy sediments and from 0.05 to 0.15 $\mu\text{g/g}$ in organic and clayey sediments. Mean levels in waste-discharge-affected areas were 0.4 to 684 $\mu\text{g/g}$. Mercury levels in fish captured in these contaminated areas ranged from 0.11 to 1.24 $\mu\text{g/g}$.

Derryberry (1972) investigated mercury levels in the Tennessee River Valley. Mercury levels of about 0.2 to 3.5 $\mu\text{g/g}$ were observed in sediments of the Tennessee River. Levels of 0.3 to 32 $\mu\text{g/g}$ were observed in Holston River sediments. Levels observed in fish were 0.3 to 3.5 $\mu\text{g/g}$ and 0.6 to 4.5 $\mu\text{g/g}$ in the Tennessee River and Holston River, respectively.

Bender et al (1972) surveyed heavy metal contamination in sediments and biota of several Virginia rivers. In areas concluded not to be influenced by man, sediment levels ranged from 0.5 to 2.5 $\mu\text{g/g}$. Mercury levels in fish, eels, oysters, and lobsters in these areas ranged from near zero to 0.22 $\mu\text{g/g}$, well below the 0.50 $\mu\text{g/g}$ limit set by the U.S. Food and Drug Administration (Bender et al. 1972).

Angino et al. (1974) studied metals in suspended sediments in Kansas streams. Their data indicate that mean lead levels ranged from 0.01 to 0.03 $\mu\text{g/g}$ and that zinc levels were generally below detectable levels. No significant correlation between metals concentrations in sediment and water was observed.

Thorne Ecological Institute (1973), in a study of Parachute Creek Valley, Colorado, noted that, although lead and mercury were not observed in water samples, some potential for bio-accumulation of these metals exists, presumably from metals found in substrate materials. Some of their data are presented below:

<u>Sample Type</u>	<u>Location</u>	<u>Mercury (ppb)</u>	<u>Lead (ppm)</u>
Substrate	Near Benson's Farm	37	11.0
Substrate	East Middle Fork	25	-
Algae	Parachute Creek near Benson's Farm	40	5.8
Algae	East Middle Fork below Revegetation Plot	48	11.4
Grass	On Revegetation Plot	69	3.4
Substrate	Straw Dam Reservoir	-	20.0

4. Data Summary

a. Headwater - A summary of data on the chemical characteristics of the sediments of the Headwater stations is shown in Tables 3-8-44 through 3-8-45. Data on stream substrate characteristics are presented in Table 3-8-10.

During the spring runoff period, the substrates of the Headwater stations are dominated by coarse sand and gravel fractions. During periods of lower flow, finer fractions (silt, clay and detritus) accumulate (Table 3-8-10.)

Mean aluminum levels in headwater sediments ranged from 3,200 to 25,050 $\mu\text{g/g}$ during the 1974-1975 survey period. In general, maximum concentrations were observed during October-November 1974. Minimum levels were observed during December-January, however the data may be influenced by the small sample size (three stations) collected during the winter survey. Although there was no consistent spatial pattern of minimum-maximum aluminum levels, maximum levels were always observed at either Station 1 or Station 5.

Mean arsenic levels in headwater sediments ranged from less than 10 to 53 $\mu\text{g/g}$. During individual surveys, maximum concentrations of arsenic were usually observed at Stations 1 or 2 (Table 3-8-44). Study maximum mean concentrations were observed during the winter (December-January) sampling period.

Table 3-3-44. Results of sediment chemistry analyses for the Headwater Stations, RBOSP Aquatic Baseline Studies from October - November 1974 sampling period through August - September 1975 sampling period. Results are expressed in $\mu\text{g/g}$ (ppm) and represent duplicate replicates unless otherwise noted.

Station	PARAMETER							
	Aluminum (Al)	Arsenic (As)	Lead (Pb)	Mercury (Hg) (ppb)	Kjeldahl N (N)	Total Phosphate (P)	Volatile Solids	Zinc (Zn)
October - November 1974 *								
1	22300	10	50	200	2300	950	98300	100
2	23500	20	60	200	1600	840	85400	90
3	17300	10	40	300	1200	1100	110000	60
4	16300	10	40	200	1000	940	58900	60
5	23400	10	30	200	890	900	56700	90
* Only one replicate was collected during October - November 1974.								
December 1974 - January 1975*								
3**	3200	53	31	887	7600	818	147000	379
4**	9200	37	28	203	1890	798	67600	47
5**	12200	26	16	104	1920	657	70500	51
*Stations 1 and 2 were inaccessible at the time of sampling								
**Only one replicate was collected during this sampling period.								
April 1975								
1	8050	37	41	<132	4760	872	126500	262
2	16350	17	14	< 56	2567	983	93050	66
3	13100	11	9	< 59	580	724	40650	50
4	10400	16	9	< 67	843	814	43550	51
5	25050	4	8	< 51	606	598	39800	57

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Table 3-8-44. (Continued)

Station	PARAMETER							
	Aluminum (Al)	Arsenic (As)	Lead (Pb)	Mercury (Hg)(ppb)	Kjeldahl N (N)	Total Phosphate (P)	Volatile Solids	Zinc (ZN)
May - June 1975								
1	15450	25	22	< 50	1842	948	75400	84
2	12750	18	16	< 50	948	934	48600	58
3	11300	8	10	< 50	1441	859	57750	53
4	13250	18	16	< 50	673	824	42300	50
5	15750	6	10	< 48	773	656	32200	50
July - August 1975								
1	14850	29	22	100	2160	930	82200	95
2	13850	30	20	200	850	973	46050	68
3	12400	8	13	100	809	566	61500	47
4	11950	22	17	<100	759	704	36550	57
5	12750	3	17	100	433	655	49750	48
August - September 1975								
1	13750	50	27	59	1185	966	60000	77
2	12150	30	19	38	814	998	49000	65
3	11700	9	19	81	4525	1030	117000	55
4	11300	13	12	24	1405	834	48600	48
5	10100	6	12	30	292	603	27100	47

Mean sediment lead levels ranged from 8 to 60 $\mu\text{g/g}$ at the Headwater stations (Table 3-8-44). Maximum concentrations were observed during October-November 1974. Generally, higher levels were observed at Stations 1 and 2 than were observed at the other Headwater stations.

Mean mercury concentrations in headwater sediments ranged from less than 48 to 887 $\mu\text{g/kg}$ (ppm) (Table 3-8-44). Maximum levels were observed during the winter (December-January) sampling period. There was no consistent pattern of maximum-minimum values among the Headwaters stations for this parameter.

Mean sediment zinc levels ranged from 47 to 379 $\mu\text{g/g}$ at Headwater stations. Maximum levels during individual surveys were usually observed at Station 1, however differences among stations were often small. Maximum observed concentrations were found during the winter and early spring (April).

The volatile solids content of sediments at Headwater stations ranged from 27,100 to 147,000 $\mu\text{g/gm}$ (Table 3-8-44). Maximum mean levels were always observed at Stations 1 or 3 and minimum levels were observed at Stations 4 or 5. Maximum levels were associated with the occurrence of considerable amounts of detrital material in stream substrates during low-flow periods.

Patterns of Kjeldahl nitrogen concentration in headwater sediments closely paralleled those of volatile solids. Kjeldahl nitrogen levels ranged from 292 to 7,600 $\mu\text{g/g}$ (Table 3-8-44). Maximum levels were observed from late fall through early spring.

Mean total phosphate concentrations ranged from 566 to 1,100 $\mu\text{g/g}$ (Table 3-8-44). Total phosphate levels in headwater sediments also generally followed the pattern of volatile solids concentrations and Kjeldahl nitrogen.

No detectable amounts of the herbicides Tordon 22K and Silvex were observed at Headwater stations, except during the winter (December-January) sampling period when Tordon 22K levels ranged from 0.4 $\mu\text{g/g}$ at Station 4 to 1.8 $\mu\text{g/g}$ at Station 3 (Table 3-8-45).

Table 3-8-45. Summary of sediment herbicide analyses for the Head-water Stations during RBOSP Aquatic Baseline Studies, October - November 1974 sampling period through August - September 1975 sampling period. (Results are expressed in $\mu\text{g/g}$ (ppm) and represent duplicate samples unless otherwise noted.)

October - November 1974 ¹		
<u>Station</u>	<u>Parameter</u>	
	<u>Tordon</u>	<u>Silvex</u>
1	<1	<0.1
2	<1	<0.1
3	<1	<0.1
4	<1	<0.1
5	<1	<0.1

¹Only one replicate was collected during October - November 1974.

Table 3-8-45. (Continued)

<u>Station Replicate</u>	December 1974 - January 1975 ¹	<u>Parameter</u>
		<u>Tordon 22K</u>
3		1.8
4		0.4
5		0.5

¹Stations 1 and 2 were dry at the time of sampling; only one replicate was collected at the remaining stations.

Table 3-3-45. (Continued)

<u>Station</u>	April 1975	<u>Parameter</u>	
		<u>Tordon 22K</u>	<u>Silvex</u>
1		<0.05	<0.05
2		<0.05	<0.05
3		<0.05	<0.05
4		<0.05	<0.05
5		<1.03	<0.05

Table 3-8-45. (Continued)

<u>Station</u>	May - June 1975	<u>Parameter</u>	
		<u>Tordon 22K</u>	<u>Silvex</u>
1		<0.02	<0.02
2		<0.02	<0.02
3		<0.02	<0.02
4		<0.02	<0.02
5		<0.02	<0.02

Table 3-8-45. (Continued)

<u>Station</u>	July - August 1975	
	<u>Tordon 22K</u>	<u>Parameter Silvex</u>
1	<0.02	<0.02
2	<0.02	<0.02
3 ²	<0.05	<0.05
4	<0.02	<0.02
5	<0.02	<0.02

² Interference

Table 3-8-45. (Continued)

<u>Station</u>	August - September 1975	
	<u>Tordon 22K</u>	<u>Silvex</u>
1	<0.02	<0.02
2	<0.02	<0.02
3	<0.50	<0.50
4	<0.02	<0.02
5	<0.02	<0.02

b. Tract - A summary of data on the chemical characteristics of the sediments of stations on or near Tract C-a is presented in Table 3-8-46 and 3-8-47. Data on stream substrate type for these stations are presented in Table 3-8-12.

Stream substrates on and near the tract are largely composed of sand and gravel, except at Station 14 which is a pool in which clay and silt components are important substrate materials (Table 3-8-12).

Mean aluminum levels in Tract station sediments ranged from 7,700 to 27,300 $\mu\text{g/g}$ (Table 3-8-46). Maximum aluminum levels observed during individual surveys were commonly found at Station 14. No other consistent patterns of sediment aluminum were evident.

Mean arsenic levels in tract sediments ranged from less than 10 to 36 $\mu\text{g/g}$ (Table 3-8-46). In general, observed arsenic levels were higher at the western end of the tract and tended to decrease downstream.

Mean sediment lead levels ranged from 7 to 56 $\mu\text{g/g}$ at Tract stations during the 1974-1975 survey period (Table 3-8-46). Maximum values during individual surveys were usually observed at Station 9.

Sediment mercury concentrations at Tract stations ranged from less than 20 to 392 $\mu\text{g/kg}$ (Table 3-8-46). Variations in mercury levels among the tract stations were generally small, except during August-September 1975 when a gradient of relatively high values at upstream stations to low values at downstream stations was observed.

Mean sediment zinc levels at Tract stations ranged from 31 to 100 $\mu\text{g/g}$ (Table 3-8-46). No consistent spatial gradients were evident, except that when stations on Stake Springs and Yellow Creek (Stations 17 and 18) were sampled, survey minimum levels of zinc were observed at these stations.

Table 3-8-46. Results of sediment chemistry analyses for the Tract Stations, RBOSP Aquatic Baseline Studies from October - November 1974 sampling period through August - September 1975 sampling period. Results are expressed in $\mu\text{g/g}$ (ppm) and represent duplicate replicates unless otherwise noted.

Station	PARAMETER							
	Aluminum (Al)	Arsenic (As)	Lead (Pb)	Mercury (Hg) (ppb)	Kjeldahl N (N)	Total Phosphate (P)	Volatile Solids	Zinc (Zn)
October - November 1974*								
7	17200	<10	40	200	1100	710	46900	70
8	22100	10	40	300	830	960	75000	60
9	19100	10	30	<200	730	880	45300	60
13	21100	10	50	200	750	860	65400	90
14	27300	<10	40	<200	1200	920	88300	100
*Stations 6, 10 - 12 and 15 - 18 were dry at the time of sampling, and only a single replicate was collected at other sites.								
December 1974 - January 1975*								
8**	11200	26	16	27	824	622	44800	54
9**	7700	35	56	263	1810	630	51600	42
13**	13800	36	35	392	1490	450	57300	86
14**	19600	30	33	268	1640	763	69800	66
*Stations 6, 7, 10-12 and 15-18 were either inaccessible, dry or frozen solid so that no samples could be obtained.								
**Only one replicate was collected during this sampling period.								
April 1975*								
7	14850	11	8	< 47	653	633	42450	48
8	23950	11	9	< 47	935	714	48850	63
9	16000	11	27	< 55	1650	674	62450	57
13	20700	7	7	< 49	644	692	42350	57
14	21400	6	8	< 51	752	589	37750	50

*Stations 6, 10-12 and 15-18 were dry at the time of sampling.

Table 3-8-46. (Continued)

Station	PARAMETER							
	Aluminum (Al)	Arsenic (As)	Lead (Pb)	Mercury (Hg) (ppb)	Kjeldahl N (N)	Total Phosphate (P)	Volatile Solids	Zinc (Zn)
May - June 1975*								
6	14100	16	16	< 50	590	705	39250	54
7	12750	9	10	< 50	1200	793	42450	88
8	10200	12	12	< 50	260	665	25450	40
9	14250	12	29	< 50	1122	829	49350	60
13	12250	9	11	< 50	261	698	27300	45
14	15300	5	8	< 50	514	569	32950	42

*Stations 6, 10-12 and 15-18 were dry at the time of sampling.

July - August 1975*								
7	10800	7	12	100	1275	722	45800	44
8	12700	9	15	<100	655	736	44200	46
9	12150	23	32	<100	573	755	34950	69
13	11150	13	18	<100	379	705	31400	49
14	15500	3	12	<100	892	641	43400	44
15	9950	9	13	<100	169	558	21400	32
17	11800	3	9	<100	222	531	22500	34
18	11400	5	12	<100	227	601	21700	31

*Stations 6, 10-12 and 16 were dry at the time of sampling.

Table 3-8 -46. (Continued)

Station	PARAMETER							
	Aluminum (Al)	Arsenic (As)	Lead (Pb)	Mercury (Hg)(ppb)	Kjeldahl N (N)	Total Phosphate (P)	Volatile Solids	Zinc (Zn)
August - September 1975*								
7	10700	17	19	51	491	771	32400	43
8	10300	19	17	54	343	694	26500	46
9	10800	25	40	59	524	758	31500	51
12	11200	26	18	<20	511	852	31550	54
13	9100	15	16	<23	413	666	25400	43
14	12000	3	10	<35	415	567	27300	36
17	12200	3	10	<20	297	578	22600	35

*Stations 6, 10, 11, 15, 16 and 18 were dry at the time of sampling.

Mean volatile solids levels ranged from 21,400 to 88,300 $\mu\text{g/g}$ during the 1974-1975 survey period (Table 3-8-46). Maximum concentrations during individual surveys were found on Corral Gulch at either Stations 7, 9 or 14. Kjeldahl nitrogen ranged from 169 to 1,810 $\mu\text{g/g}$ and total phosphate ranged from 450 to 960 $\mu\text{g/g}$ in sediments. These parameters generally followed the same maximum-minimum patterns as those observed for volatile solids levels (Table 3-8-46).

Measurable levels of the herbicides Tordon 22K in tract sediments were observed only during the three surveys conducted between October-November 1974 to April 1975. Observed concentrations of Tordon 22K ranged from not measurable to 1.7 $\mu\text{g/g}$ (Table 3-8-47). Mean concentrations of Silvex were below measurable limits at all times.

c. Yellow Creek - A summary of data collected on the chemical characteristics of the sediments of the Yellow Creek stations is shown in Tables 3-8-48 and 3-8-49. Data on stream substrate type are presented in Table 3-8-14.

Stream substrates of the Yellow Creek stations are dominated by sand and gravel fractions. In addition, silt and detritus sometimes make up a considerable proportion of the substrate material.

Mean aluminum levels in Yellow Creek sediments ranged from 4,200 to 24,300 $\mu\text{g/g}$ during the 1974-1975 survey period. During individual surveys, maximum sediment aluminum concentrations were observed at Stations 19 or 20. Study maximum concentrations were observed during October-November 1974.

Mean sediment arsenic concentrations at Yellow Creek stations ranged from less than 10 to 13 $\mu\text{g/g}$. All mean values observed during 1974 surveys were less than 10 $\mu\text{g/g}$ (Table 3-8-48). Differences between stations during individual surveys and differences across time were relatively small.

Table 3-8-47. Summary of sediment herbicide analyses for the Tract Stations during RBOSP Aquatic Baseline Studies, October - November 1974 sampling period through August - September 1975 sampling period. (Results are expressed in $\mu\text{g/g}$ (ppm) and represent duplicate samples unless otherwise noted.

<u>Station</u>	October - November 1974 ¹	
	<u>Tordon 22K</u>	<u>Silvex</u>
7	1	<0.1
8	<1	<0.1
9	<1	<0.1
13	<1	<0.1
14	<1	<0.1

¹Stations 6, 10 - 12, and 15 - 18 were dry at the time of sampling; only one replicate was collected at the remaining stations.

Table 3-8-47. (Continued)

December 1974 - January 1975 ¹	
<u>Station</u>	<u>Parameter</u>
<u>Replicate</u>	
	Tordon 22K
8	0.6
9	0.6
13	0.3
14	0.5

¹Stations 6, 7, 10 - 12, and 15 - 18 were dry at the time of sampling; only one replicate was collected at the remaining stations.

Table 3-8-47. (Continued)

<u>Station</u>	April 1975	<u>Parameter</u>	
		<u>Tordon</u>	<u>22K</u> <u>Silvex</u>
7		1.70	<0.05
8		<0.05	<0.30
9		0.25	<0.05
13		<0.38	<0.05
14		0.15	<0.05

Table 3-8-47. (Continued)

<u>Station</u>	May - June 1975	<u>Parameter</u>	
		<u>Tordon 22K</u>	<u>Silvex</u>
6		<0.02	<0.02
7		<0.02	<0.02
8		<0.02	<0.02
9		<0.02	<0.02
13		<0.02	<0.02
14		<0.02	<0.02

Table 3-3-47. (Continued)

Station	July - August 1975	Parameter	
		Tordon 22K	Silvex
7 ²		<0.26	<0.26
8		<0.02	<0.02
9		<0.02	<0.02
13		<0.02	<0.02
14		<0.02	<0.02
15		<0.02	<0.02
17		<0.02	<0.02
18		<0.02	<0.02

¹ Stations 6, 10 - 12, and 16 were dry at the time of sampling.

² Interference

Table 3-8-47. (Continued)

<u>Station</u>	August - September 1975	<u>Parameter</u>	
		<u>Tordon 22K</u>	<u>Silvex</u>
7		<0.02	<0.02
8		<0.02	<0.02
9		<0.02	<0.02
12		<0.02	<0.02
13		<0.02	<0.02
14		<0.02	<0.02
17		<0.02	<0.02

¹ Stations 6, 10-12 and 15-18 were dry at the time of sampling.

Table 3-8 -48. Results of sediment chemistry analyses for the Yellow Creek Stations, RBOSP Aquatic Baseline Studies from October - November 1974 sampling period through August - September 1975 sampling period. Results are expressed in $\mu\text{g/g}$ (ppm) and represent duplicate replicates unless otherwise noted.

Station	PARAMETER							
	Aluminum (Al)	Arsenic (As)	Lead (Pb)	Mercury (Hg)(ppb)	Kjeldahl N (N)	Total Phosphate (P)	Volatile Solids	Zinc (Zn)
October - November 1974*								
19	21400	10	80	<200	1100	910	69600	90
20	24300	10	50	400	760	610	64100	70
21	20600	10	30	200	1000	750	42200	70
22	21100	10	40	300	1600	580	72000	60
*Only one replicate was collected during this sampling period.								
December 1974 - January 1975*								
19**	12500	11	23	389	1690	602	73400	52
22**	6800	13	14	1240	329	497	21600	28
*Stations 20 and 21 were inaccessible during time of sampling.								
**Only one replicate was collected during this sampling period.								
April 1975								
19	24050	5	9	<54	2288	774	77000	57
20	6100	7	6	<51	183	462	16450	33
21	4200	6	6	<53	177	512	11050	25
22	5000	5	6	<48	236	467	15250	26

Table 3-3 -48. (Continued)

Station	PARAMETER							
	Aluminum (Al)	Arsenic (As)	Lead (Pb)	Mercury (Hg) (ppb)	Kjeldahl N (N)	Total Phosphate (P)	Volatile Solids	Zinc (Zn)
May - June 1975								
19	16050	5	9	< 50	1542	749	42800	52
20	5250	7	7	< 77	186	529	19950	27
21	4800	9	7	< 136	175	553	16950	26
22	10300	6	7	< 50	320	570	23350	31
July - August 1975								
19	17550	5	16	200	2345	964	76900	65
20	13900	9	12	100	715	705	34800	58
21	7600	5	8	200	185	545	18150	35
22	5650	3	8	200	165	536	14250	31
August - September 1975								
19	7550	4	7	< 20	177	649	17250	28
20	14400	7	11	67	710	659	38550	53
21	7550	7	11	< 20	199	555	19800	33
22	4350	5	6	6	118	608	13300	26

Mean sediment lead concentrations ranged from 6 to 80 $\mu\text{g/g}$ during the 1974-1975 survey period. Maximum mean values observed during individual surveys were usually found at Station 19. Study maximum levels were observed during October-November 1974. Mean values observed for 1975 surveys were always 16 $\mu\text{g/g}$ or less (Table 3-8-48) and differences between stations were generally small.

Mean sediment mercury concentrations in Yellow Creek sediments ranged from less than 20 to 1,240 $\mu\text{g/kg}$. Study maximum values were observed during the winter (December-January) sampling period. Most of the mean values indicated that mercury levels were below detectable levels.

Mean zinc levels in sediments collected at Yellow Creek stations ranged from 25 to 90 $\mu\text{g/g}$ (Table 3-8-48). Maximum concentrations for individual surveys were usually observed at Stations 19 or 20; levels tended to decrease in the downstream direction. Except for the relatively high sediment zinc levels observed during the October-November 1974 sampling period, observed mean concentrations were relatively constant throughout the study period.

The volatile solids content of Yellow Creek sediments ranged from 11,050 to 77,000 $\mu\text{g/g}$ during the study period (Table 3-8-48). Maximum volatile solids concentrations were usually found at Stations 19 or 20. A similar spatial pattern was observed for sediment Kjeldahl nitrogen and total phosphate concentrations, for which ranges of 118 to 2,288 g/g and 462 to 964 $\mu\text{g/g}$, respectively, were observed.

Detectable amounts of the herbicide Silvex were not observed in Yellow Creek sediments during the 1974-1975 study period (Table 3-8-49). The herbicide Tordon 22K was usually below detectable limits; however, during the October-November and December-January surveys detectable amounts (up to 1 $\mu\text{g/g}$) were observed.

Table 3-8-49. Summary of sediment herbicide analyses for the Yellow Creek Stations during RBOSP Aquatic Baseline Studies, October - November 1974 sampling period through August - September 1975 sampling period. (Results are expressed in $\mu\text{g/g}$ (ppm) and represent duplicate samples unless otherwise noted.)

October - November 1974 ¹		
<u>Station</u>	<u>Parameter</u>	
	<u>Tordon 22K</u>	<u>Silvex</u>
19	1	<0.1
20	1	<0.1
21	1	<0.1
22	<1	<0.1

¹Only one replicate was collected during October - November 1974.

Table 3-3 -49. (Continued)

December 1974 - January 1975 ¹	
<u>Station Replicate</u>	<u>Parameter</u>
	Tordon 22K
19	0.4
22	0.4

¹Stations 20 and 21 were dry at the time of sampling; only one replicate was collected at the remaining stations.

Table 3-3-49. (Continued)

<u>Station</u>	April 1975	<u>Parameter</u>	
		<u>Tordon 22K</u>	<u>Silvex</u>
19		<0.05	<0.05
20		<0.08	<0.05
21		<0.05	<0.05
22		<0.05	<0.05

Table 3-3-49. (Continued)

<u>Station</u>	May - June 1975	<u>Parameter</u>	
		<u>Tordon 22K</u>	<u>Silvex</u>
19		<0.02	<0.02
20		<0.02	<0.02
21		<0.02	<0.02
22		<0.02	<0.02

Table 3-8-49. (Continued)

<u>Station</u>	July - August 1975	<u>Parameter</u>	
		<u>Tordon 22K</u>	<u>Silvex</u>
19		<0.02	<0.02
20		<0.02	<0.02
21		<0.02	<0.02
22		<0.02	<0.02

Table 3-8-49. (Continued)

<u>Station</u>	August - September 1975	
	<u>Tordon</u>	<u>Parameter</u> <u>22K</u> <u>Silvex</u>
19	<0.02	<0.02
20	<0.02	<0.02
21	<0.02	<0.02
22	<0.02	<0.02

d. White River - Data collected on the chemical characteristics of sediments in the White River are summarized in Tables 3-8-50 and 3-8-51. Data on stream substrate characteristics are presented in Table 3-8-16.

Substrate materials observed in the White River are coarse relative to those found in other station zones. Cobble and gravel substrates predominate. Sand, silt and detritus become more important during relatively low flow periods (Table 3-8-16).

Mean sediment aluminum concentrations ranged from 3,100 to 20,400 $\mu\text{g/g}$ at White River stations during the 1974-1975 study period (Table 3-8-50). The highest levels observed were found during October-November 1974. No consistent patterns of sediment aluminum were evident. However, during low flow periods (late summer through winter), maximum concentrations for individual surveys were observed at stations at the confluence with Yellow Creek.

Mean sediment arsenic levels ranged from less than 1 to 20 $\mu\text{g/g}$ at White River stations. Study maximum levels were observed during the October-November and December-January surveys. During the 1975 surveys, all observed means were 10 $\mu\text{g/g}$ or less, as were most observations for the 1974 surveys. During individual surveys, sediment arsenic levels were similar throughout the White River study area.

Mean sediment lead levels at White River stations ranged from less than 10 to 760 $\mu\text{g/g}$ (Table 3-8-50). Maximum observed concentrations were found during October-November 1974; during 1975, values were generally 10 $\mu\text{g/g}$ or less. During individual survey periods, sediment lead concentrations were fairly uniform throughout the White River study area.

During the 1974-1975 study period, sediment mercury levels in the White River ranged from less than 47 to 6,200 $\mu\text{g/kg}$. Study maximum concentrations were observed during October-November 1974. No consistent patterns of variation of sediment mercury were found.

Table 3-3 -50. Results of sediment chemistry analyses for the White River Stations, RBOSP Aquatic Baseline Studies from October - November 1974 sampling period through August - September 1975 sampling period. Results are expressed in $\mu\text{g/g}$ (ppm) and represent duplicate replicates unless otherwise noted.

Station	PARAMETER							
	Aluminum (Al)	Arsenic (As)	Lead (Pb)	Mercury (Hg)(ppb)	Kjeldahl N (N)	Total Phosphate (P)	Volatile Solids	Zinc (Zn)
October - November 1974								
Above Confluence with Yellow Creek								
23*	17700	10	40	200	890	540	38500	70
24	13200	10	10	300	580	800	38900	60
25	19200	20	760	6200	1040	1030	57800	580
26	17600	<10	10	400	550	600	38500	90
27	13100	<10	50	<300	270	780	37300	90
At Confluence with Yellow Creek								
28	16200	<10	10	<200	600	820	42000	80
29	17800	<10	10	1300	540	820	57900	100
Below Confluence with Yellow Creek								
30	16800	<10	10	<200	880	830	40100	80
31	6900	<10	10	<200	2300	950	74600	50
32	16800	<10	10	<200	1000	710	41900	90
33	16000	<10	10	<200	1850	850	55900	80
34	19400	<10	10	400	1300	760	52000	110
35	20400	<10	10	<300	840	660	46500	90

*Data are results of analysis of a single replicate.

Table 3-3 -50. (Continued)

Station	PARAMETER							
	Aluminum (Al)	Arsenic (As)	Lead (Pb)	Mercury (Hg)(ppb)	Kjeldahl N (N)	Total Phosphate (P)	Volatile Solids	Zinc (Zn)
December 1974 - January 1975 *								
Above Confluence with Yellow Creek								
23**	4100	2	11	121	170	414	9300	21
At Confluence with Yellow Creek								
28	10000	20	22	500	966	558	42800	44
Below Confluence with Yellow Creek								
34	4500	6	14	488	677	445	17700	28

*Stations 24-27, 29-33 and 35 were inaccessible during time of sampling.

**Only one replicate was collected during this sampling period.

Table 3-3-50. (Continued)

Station	PARAMETER							
	Aluminum (Al)	Arsenic (As)	Lead (Pb)	Mercury (Hg)(ppb)	Kjeldahl N (N)	Total Phosphate (P)	Volatile Solids	Zinc (Zn)
April 1975								
Above Confluence with Yellow Creek								
23	9600	3	8	<58	840	638	38300	40
24	6600	5	5	<47	326	386	20700	30
25	3100	10	4	<55	107	682	10950	21
26	3200	7	3	<56	144	673	8450	22
27	7050	6	7	<57	1062	567	27350	45
At Confluence with Yellow Creek								
28	5550	6	4	<48	228	498	17400	35
29	13150	5	10	<49	1703	712	68700	61
Below Confluence with Yellow Creek								
30	3400	5	3	<56	220	612	20150	37
31	3450	5	4	<48	234	614	20250	37
32	4100	6	4	<51	217	417	20350	33
33	4750	8	5	<79	609	507	29200	33
34	9750	6	9	<47	1834	683	60300	64
35	8900	5	5	<48	620	459	31950	32

3-8-209

Table 3-3-50. (Continued)

Station	PARAMETER							
	Aluminum (Al)	Arsenic (As)	Lead (Pb)	Mercury (Hg)(ppb)	Kjeldahl N (N)	Total Phosphate (P)	Volatile Solids	Zinc (Zn)
May - June 1975								
Above Confluence with Yellow Creek								
23	4150	5	5	<50	176	389	10300	21
24	8750	6	5	<49	505	637	23900	56
25	6900	5	6	<49	304	543	17350	31
26	3550	6	4	<50	137	432	10070	21
27	7500	5	4	<50	243	505	14950	28
At Confluence with Yellow Creek								
28	5700	5	4	<50	222	412	12150	24
29	5950	6	5	<49	235	442	15750	25
Below Confluence with Yellow Creek								
30	4600	6	6	<50	187	424	12900	29
31	4700	6	5	<50	159	406	10850	22
32	4600	6	6	<50	198	456	13800	22
33	6750	6	5	<50	503	549	23400	30
34	5150	5	4	<50	187	453	13100	22
35	6250	6	4	<50	270	459	15700	26

Table 3-3-50. (Continued)

Station	PARAMETER							
	Aluminum (Al)	Arsenic (As)	Lead (Pb)	Mercury (Hg)(ppb)	Kjeldahl N (N)	Total Phosphate (P)	Volatile Solids	Zinc (Zn)
July - August 1975								
Above Confluence with Yellow Creek								
23	5150	4	7	<100	270	452	15400	26
24	4700	2	6	<100	254	407	14100	26
25	3650	6	7	<100	125	678	10050	64
26	4300	4	5	<100	217	419	11700	34
27	4550	2	5	<100	277	361	10300	22
At Confluence with Yellow Creek								
28	7200	3	6	<100	278	430	16700	33
29	4150	3	7	<100	216	409	9855	23
Below Confluence with Yellow Creek								
30	4000	3	4	100	235	371	10300	20
31	3450	5	6	100	142	638	8785	26
32	4700	2	8	600	194	343	10350	21
33	7600	2	8	200	645	428	20900	31
34	4600	3	9	<100	157	447	11100	25
35	5400	<1	6	<100	238	358	11600	28

3-8-211

Table 3-3-50. (Continued)

Station	PARAMETER							
	Aluminum (Al)	Arsenic (As)	Lead (Pb)	Mercury (Hg)(ppb)	Kjeldahl N (N)	Total Phosphate (P)	Volatile Solids	Zinc (Zn)
August - September 1975								
Above Confluence with Yellow Creek								
23	4850	5	6	35	257	468	16950	26
24	4900	3	5	44	264	416	14900	26
25	3250	5	7	32	135	798	9690	27
26	5700	3	7	68	553	401	22850	30
27	8100	3	8	28	1085	516	42950	40
At Confluence with Yellow Creek								
28	10300	4	10	57	1705	857	52850	48
29	8600	4	10	35	906	717	37950	43
Below Confluence with Yellow Creek								
30	9600	4	10	49	1670	793	50850	47
31	3250	6	6	61	91	781	7860	24
32	3450	3	5	45	156	396	9805	24
33	4200	3	7	66	258	366	12950	23
34	4150	6	8	26	215	550	13100	28
35	8100	4	11	33	714	555	31400	39

3-8-212

Sediment zinc concentrations at White River stations ranged from 20 to 580 $\mu\text{g/g}$ (Table 3-8-50). The maximum observed means were found during October-November 1974. No consistent patterns of variation were found.

Sediment volatile solids content at White River stations ranged from 579 to 74,600 $\mu\text{g/g}$. Study maximum levels were observed during October-November 1974 (Table 3-8-50). Variations in Kjeldahl nitrogen and total phosphate levels in White River sediments appeared closely related to variations in volatile solids levels. There were, however, no consistent spatial patterns for these parameters.

No detectable amounts of the herbicide Silvex were found in White River sediments (Table 3-8-51). Levels of Tordon 22K were usually below the limits of analysis but measurable amounts, ranging from 0.4 to 3.0 $\mu\text{g/g}$, were found during the October through April sampling periods.

5. Discussion - Data on sediment chemical characteristics was collected primarily to define ambient conditions for comparison with levels during tract development. In general, the concentrations of sediment metals (aluminum, arsenic, lead, mercury and zinc) and organic-related constituents (volatile solids, Kjeldahl nitrogen and total phosphate) tend to decrease from the headwaters to the White River. In addition to geographic location, sediment characteristics are also influenced to some extent by hydrologic conditions. For some parameters (e.g., volatile solids, Kjeldahl nitrogen, mercury and arsenic), study maximum values (147,000 $\mu\text{g/g}$, 7600 $\mu\text{g/g}$, 1240 $\mu\text{g/kg}$, and 53 $\mu\text{g/g}$, respectively) were observed during relatively low flow periods. These trends were somewhat less evident in the White River, which was a relatively homogeneous environment relative to the other watershed segments studied.

The widespread use of pesticides has resulted in the ubiquitous nature of the residues of these materials. In aquatic ecosystems, pesticides commonly become associated with particulate organic and mineral components of

Table 3-8-51. Summary of sediment herbicide analyses for the White River Stations during RBOSP Aquatic Baseline Studies, October - November 1974 sampling period through August - September 1975 sampling period. (Results are expressed in $\mu\text{g/g}$ (ppm) and represent duplicate samples unless otherwise noted.)

October - November 1974

<u>Station</u>	<u>Parameter</u>	
	<u>Tordon</u>	<u>22K</u> <u>Silvex</u>
Above Confluence with Yellow Creek		
23*	<1	<0.1
24	2	<0.1
25	<1	<0.1
26	<1	<0.1
27	<1	<0.1
At Confluence with Yellow Creek		
28	2	<0.1
29	<1	<0.1
Below Confluence with Yellow Creek		
30	<1	<0.1
31	<1	<0.1
32	2	<0.1
33	<1	<0.1
34	<1	<0.1
35	<1	<0.1

*Only one replicate was collected for Station 23.

Table 3-8-51. (Continued)

December 1974 - January 1975		
<u>Station</u> <u>Replicate</u>		<u>Parameter</u>
		Tordon 22K
	Above Confluence with Yellow Creek	
23		0.4
	At Confluence with Yellow Creek	
28		0.4
	Below Confluence with Yellow Creek	
34		0.4

¹ Stations 24 - 27, 29 - 33, and 35 were dry at the time of sampling.

Table 3-8-51. (Continued)

<u>Station</u>	April 1975	<u>Parameter</u>	
		<u>Tordon 22K</u>	<u>Silvex</u>
Above Confluence with Yellow Creek			
23		<0.05	<0.05
24		<0.05	<0.05
25		<0.05	<0.05
26		<0.05	<0.05
27		<0.05	<0.05
At Confluence with Yellow Creek			
28		<0.05	<0.05
29		<0.05	<0.05
Below Confluence with Yellow Creek			
30		<0.05	<0.05
32		<0.05	<0.05
33		3.00	<0.05
34		1.60	<0.05

Table 3-3-51. (Continued)

<u>Station</u>	May - June 1975	<u>Parameter</u>	
		<u>Tordon 22K</u>	<u>Silvex</u>
Above Confluence with Yellow Creek			
23		<0.02	<0.02
24		<0.02	<0.02
25		<0.02	<0.02
26		<0.02	<0.02
27		<0.02	<0.02
At Confluence with Yellow Creek			
28		<0.02	<0.02
29		<0.02	<0.02
Below Confluence with Yellow Creek			
30		<0.02	<0.02
31		<0.02	<0.02
32		<0.02	<0.02
33		<0.02	<0.02
34		<0.02	<0.02
35		<0.02	<0.02

Table 3-8-51. (Continued)

<u>Station</u>	July - August 1975	<u>Parameter</u>	
		<u>Tordon 22K</u>	<u>Silvex</u>
Above Confluence with Yellow Creek			
23		<0.02	<0.02
24		<0.02	<0.02
25		<0.02	<0.02
26		<0.02	<0.02
27		<0.02	<0.02
At Confluence with Yellow Creek			
28		<0.02	<0.02
29		<0.02	<0.02
Below Confluence with Yellow Creek			
30		<0.02	<0.02
31		<0.02	<0.02
32		<0.02	<0.02
33		<0.02	<0.02
34		<0.02	<0.02
35		<0.02	<0.02

Table 3-8-51. (Continued)

August - September 1975		
<u>Station</u>	<u>Parameter</u>	
	<u>Tordon 22K</u>	<u>Silvex</u>
Above Confluence with Yellow Creek		
23	<0.02	<0.02
24	<0.02	<0.02
25	<0.02	<0.02
26	<0.02	<0.02
27	<0.02	<0.02
At Confluence with Yellow Creek		
28	<0.02	<0.02
29	<0.02	<0.02
Below Confluence with Yellow Creek		
30	<0.02	<0.02
31	<0.02	<0.02
32	<0.02	<0.02
33	<0.02	<0.02
34	<0.02	<0.02
35	<0.02	<0.02

the substrate. This accumulation often results in concentrations many times those observed in waters overlying these substrates (Fetz et al., 1971; Federal Working Group on Pest Management, 1974).

In general, the concentrations of the herbicides Tordon 22K and Silvex in stream sediments near Tract C-a were below the measurable limits of the analytical method. Measurable amounts of Silvex were never observed. Tordon 22K was only found in measurable amounts during the fall (October) through spring (April) period in all four of the watershed segments considered (headwaters, tract, Yellow Creek and White River). These observations may be associated with the accumulation of organic matter and finer sediment mineral fractions during these relatively low flow periods.

D. Comprehensive Water Quality Studies

1. Objectives - The objective of this aspect of the RBOSP Aquatic Baseline Studies is to conduct comprehensive water quality studies of the White River in order to establish a baseline for parameters not included under Sections 8.1A (Physical Measurements) or 8.1B (Chemical Measurements).

2. Methods - Beginning in April 1975, duplicate water quality samples were obtained from the White River above (Station 25) and below (Station 34) Yellow Creek in accordance with the schedule outlined in Table 3-8-9.. Laboratory analyses were performed in accordance with the methods referenced in Table 3-8-10. In addition, a spectrographic element scan was made of duplicate water samples on a quarterly basis. For each replicate sample, 2 liters of water were filtered and evaporated to dryness in the lab. The residue was dried at 105°C and the loss on ignition was determined at 800°C. The ash was then subjected to spectrographic analysis.

3. Literature Review - A limited amount of water quality data is available for the White River in the vicinity of Tract C-a.

Pennak (1974) evaluated the limnological status of streams in the Piceance Basin during the summer of 1973. Sample Station 3 of his study was located on the White River 0.5 mi (0.8 km) below the mouth of Piceance Creek. Water quality data reported at this station (Table 3-8-11) can be used to a limited extent in evaluating conditions of the White River above the confluence with Yellow Creek.

Wilber (1974) evaluated water quality in the oil shale regions of Colorado. Station 13 (White River below Piceance Creek) and 15 (White River 5 miles (8 km) east of Rangely) provided some indication of the White River water quality above and below Yellow Creek. Wilber's data are presented in Table 3-8-11.

Table 3-8-52. Water quality sampling frequency for RBOSP Aquatic Baseline Studies.

<u>Parameter</u>	<u>Semi-Monthly</u>	<u>Quarterly</u>
Arsenic (As), Diss	+	+
Barium (Ba), Diss	+	+
Boron (B), Diss	+	+
Cadmium (Cd), Diss	+	+
Carbon (C), Organic		+
Carbon (C), Organic Diss		+
Carbon (c), Organic Suspended		+
Chemical Oxygen Demand (O ₂)		+
Chromium (Cr), Total Diss ²	+	+
Copper (Cu), Diss	+	+
Cyanide (Cn), Total	+	+
Fluoride (F), Diss	+	+
Iron (Fe), Total Diss	+	+
Lead (Pb), Diss	+	+
Lithium (li), Diss	+	+
Manganese (Mn), Diss	+	+
Mercury (Hg), Diss	+	+
Nitrogen (N), Organic		+
Phosphorus (P), Total Diss	+	+
Phenolic compounds (Phenol)		+
Selenium (Se), Diss	+	+
Solvent extract (Oil)	+	+
Sulfate (S), Diss	+	+
Sulfide (S), Diss	+	+
Sulfur (S), Organic		+
Zinc (Zn), Diss	+	+
Fecal coliform bacteria		+
Pesticides		+
Radioactivity		+

Diss=Dissolved

Table 3-8-53. Water quality laboratory analysis methods for RBOSP Aquatic Baseline Studies.

<u>Parameter</u>	<u>Method Reference</u>
Arsenic (As), Diss	AA
Barium (Ba), Diss	AA
Boron (B), Diss	APHA - Carmine
Cadmium (Cd), Diss	AA
Carbon (C), Organic	Beckman Analyzer
Carbon (C), Organic Diss	Beckman Analyzer
Carbon (C), Organic Suspended	Beckman Analyzer
Chemical Oxygen Demand (O ₂)	Dichromate Reflux
Chromium (Cr), Total Diss	AA
Copper (Cu), Diss	AA
Cyanide (Cn), Total	EPA (1971)
Fluoride (F), Diss	Orion Sp. Ion Electrode
Iron (Fe), Total Diss	AA
Lead (Pb), Diss	AA
Lithium (Li), Diss	AA
Manganese (Mn), Diss	AA
Mercury (Hg), Diss	Flameless AA
Nitrogen (N), Organic	Kjeldahl minus Ammonia
Phosphorus (P), Total Diss	EPA (1971)
Phenolic compounds (Phenol	Distillation 4 - AAP
Selenium (Se), Diss	ASTM - Diaminobenzidine
Solvent extract (Al)	CCl ₄ Extn. - IR
Sulfate (S), Diss	Gravimetric
Sulfide (S), Diss	APHA - Methylene Blue
Sulfur (S), Organic	Total (API) minus Total Inorganic
Zinc (Zn), Diss	AA
Fecal coliform	APHA
Lindane	GC
Malathion	GC
Parathion	GC
Toxaphene	GC
Radioactivity	Filtration, evaporation; low back-ground, end window proportional counter

Diss=Dissolved

AA =Atomic Absorption

EPA =Environmental Protection Agency (1971)

APHA=American Public Health Association (1971)

GC =Gas chromatography

Table 3-8-54. Water quality literature review data (data are expressed as mean values in mg/l unless otherwise noted.)

Parameter	Above Yellow Creek			Below Yellow Creek	
	Pennak (1974) Station 3	Wilber (1974) Station 13	Everhart and May (1973) Station VII	Wilber (1974) Station 15	Everhart and May (1973) Station VIII
Suspended Inorganic Material	42.4	--	--	--	--
Suspended Organic Material	6.2	--	--	--	--
Dissolved Inorganic Material	324.6	--	--	--	--
Dissolved Organic Material	97.0	--	--	--	--
Filtrable Solids	--	--	384.5	--	406.1
Nonfiltrable Solids	--	--	252.5	--	605.0
Total Residue	--	--	617.1	--	976.6
Settleable Solids	--	--	0.4	--	2.0
pH	8.2	--	--	--	8.1
Chloride (Cl)	24.2	--	15.9	88	17.5
Hardness (grains/gallon)	--	15	--	13	--
Nitrate (NO ₃)	--	1.4	0.6	--	1.1
Conductivity (micromhos)	--	575	6.8	--	636
Fluoride	--	0.1	--	--	--
Salinity (NaCl)	--	280	--	--	--
Turbidity (JTU)	--	--	<28	--	<38
Dissolved Oxygen	--	--	9.7	--	9.3
Alkalinity, Phth	--	--	4.2	--	6.3
Alkalinity, Total	103.7	--	186.9	--	169.1
Calcium (Ca)	176.0	5.5	66.7	--	67.0
Magnesium (Mg)	--	9.2	20.1	--	20.5
Sodium (Na)	26.9	--	45.5	--	41.0
Pottasium (K)	--	--	2.5	--	2.9
Sulfate (SO ₄)	189.3	--	135.2	--	139.8
Silica (SiO ₂)	--	--	16.7	--	16.7

3-8-224

Everhart and May (1973) evaluated the effects of chemical variations on the biota and chemistry of Piceance Creek. Sample Stations VII and VIII of their study provide some indication of White River water quality above and below Yellow Creek. The data are listed in Table 3-8-11.

The White River from the mouth of the Piceance Creek to the Colorado-Utah State line is classified as a B₂ water (Colorado Water Quality Control Commission, 1974). Class B₂ waters are designated as suitable for or to become suitable for all purposes for which raw water is customarily used, except primary contact recreation, such as swimming and water skiing. The water exhibits or is to exhibit the following characteristics:

- Bacteriological concentrations do not exceed a geometric mean of 10,000 total coliform groups or 1,000 fecal coliform groups per 100 milliliters based on a minimum of not less than five samples obtained during separate 24-hour periods for any 30-day period, nor do 10 percent of the fecal coliform samples exceed 2,000 per 100 milliliters during any 30-day period.
- The dissolved oxygen concentration is not less than 5 milligrams per liter.
- A pH of not less than 6.0 nor more than 9.0.
- Temperature maintains a normal pattern of diurnal and seasonal fluctuations and does not change abruptly. No warming discharge is permitted in the hypolimnion of lakes or reservoirs. Temperature is not increased by discharges more than 5°F. in streams and more than 3°F. in the epilimnion of lakes or reservoirs.
- Wastes of other than natural origin does not cause the turbidity of water to be increased by more than ten Jackson Units or its equivalent.

4. Data Summary - Tables 3-8-12 and 3-8-17 include data from the RBOSP water quality studies of the White River above (Station 25) and below (Station 34) the confluence with Yellow Creek.

Table 3-8-55. Water quality data for RBOSP Aquatic Baseling Studies (data are expressed as mean values in mg/l unless otherwise noted.)

Parameter	April 1975		May-June 1975		August-September 1975		Overall Mean Values	
	Station 25	Station 34	Station 25	Station 34	Station 25	Station 34	Station 25	Station 34
Arsenic (As), Diss	<0.01	<0.01	<0.03	<0.03	<0.01	<0.01	<0.02	<0.02
Barium (Ba), Diss	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Boron (B), Diss	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cadmium (Cd), Diss	<0.01	<0.01	--	--	<0.01	<0.01	<0.01	<0.01
Carbon (C), Organic	14	12	--	--	<1	<1	<8	<7
Carbon (C), Organic Diss	12	11	--	--	2	<1	7	<6
Carbon (C), Organic Suspended	3	2	--	--	<1	<1	<2	<2
Chemical Oxygen Demand (O ₂)	23	17	--	--	10	10	17	14
Chromium (Cr), Total Diss	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Copper (Cu), Diss	<0.03	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Cyanide (Cn), Total	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Fluoride (F), Diss	0.60	0.70	0.07	0.06	<0.40	0.44	0.357	0.400
Iron (Fe), Total Diss	0.02	0.02	0.05	0.05	0.04	<0.02	0.04	0.03
Lead (Pb), Diss	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Lithium (Li), Diss	0.02	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Manganese (Mn), Diss	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Mercury (Hg), Diss (ug/l)	3.5	0.3	0.7	0.7	0.3	<0.3	1.5	<0.4
Nitrogen (N), Organic	0.94	0.65	--	--	0.31	0.30	0.63	<0.48
Phosphorus (P), Total Diss	0.04	<0.03	0.02	0.03	0.02	0.02	0.03	0.03
Phenolic compounds (Phenol)	0.01	0.01	--	--	0.02	0.02	0.02	0.02
Selenium (Se), Diss	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Solvent extract (Oil)	0.130	0.150	<0.160	<0.022	<0.003	<0.003	<0.050	<0.058
Sulfate (S), Diss	55	51	16	16	51	58	41	42
Sulfide (S), Diss	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Sulfur (S), Organic	<1	<2	--	--	5	5	<3	<4
Zinc (Zn), Diss	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02

Diss=Dissolved

Table 3-8 -56. Summary of fecal coliform analysis from water quality studies, RBOSP Aquatic Baseline Studies, April and August - September 1975. (Results are expressed as means of number of colonies/100 ml.)

<u>Station-Replicate</u>	<u>Colonies/100 ml</u>
April 1975	
25	65
34	50
August - September 1975	
25	13
34	21

Table 3-8-57. Summary of radiological analyses for White River water quality studies, RBOSP Aquatic Baseline Studies. (Data are expressed in pCi/l.)

	<u>Station Replicate</u>			
	25		34	
	<u>A</u>	<u>B</u>	<u>A</u>	<u>B</u>
	April 1975			
Gross Alpha (α)	1.2 $\pm$ 0.8	1.2 $\pm$ 0.8	1.3 $\pm$ 0.8	0.83 $\pm$ 0.65
Gross (β) Beta	10.1 $\pm$ 1.6	9.4 $\pm$ 1.5	9.4 $\pm$ 1.5	8.0 $\pm$ 1.4
	August - September 1975			
Gross Alpha (α)	<0.56	<0.64	<0.52	<0.54
Gross (β) Beta	3.4 $\pm$ 0.8	2.6 $\pm$ 0.8	3.6 $\pm$ 0.9	3.6 $\pm$ 0.9

Table 3-8-58. Water quality data spectrographic element scan for RBOSP Aquatic Baseline Studies April 1975. (Data are means of two samples expressed in mg/l and are based upon dissolved solids.)

Parameter	Station	
	<u>25</u>	<u>34</u>
Aluminum (Al)	0.01	0.02
Antimony (Sb)	ND	ND
Arsenic (As)	ND	ND
Barium (Ba)	0.017	0.017
Beryllium (Be)	ND	ND
Bismuth (Bi)	ND	ND
Boron (B)	0.02	0.02
Cadmium (Cd)	ND	ND
Calcium (Ca)	54.3	53.5
Chromium (Cr)	ND	ND
Cobalt (Co)	ND	ND
Copper (Cu)	0.003	0.003
Germanium (Ge)	ND	ND
Iron (Fe)	0.011	0.013
Lead (Pb)	ND	ND
Magnesium (Mg)	22.8	22.7
Manganese (Mn)	ND	ND
Molybdenum (Mo)	ND	ND
Nickel (Ni)	ND	ND
Potassium (K)	6.3	6.4
Silica (Si)	0.07	0.09
Sodium (Na)	189	186
Strontium (Sr)	2.4	2.8
Tellurium (Te)	ND	ND
Tin (Sn)	ND	ND
Titanium (Ti)	ND	ND
Vanadium (V)	ND	ND
Tungsten (W)	ND	ND
Zirconium (Zr)	ND	ND

ND=Not Detected

Table 3-8-59. Water quality data spectrographic element scan for RBOSP Aquatic Baseline Studies, August - September 1975. (Data are means of two samples expressed in mg/l and are based upon dissolved solids.)

Parameter	Station	
	25	34
Aluminum (Al)	0.008	<0.002
Antimony (Sb)	ND	ND
Arsenic (As)	ND	ND
Barium (Ba)	0.10	0.10
Beryllium (Be)	ND	ND
Bismuth (Bi)	ND	ND
Boron (B)	0.005	0.003
Cadmium (Cd)	ND	ND
Calcium (Ca)	179	157
Chromium (Cr)	<0.002	<0.002
Cobalt (Co)	ND	ND
Copper (Cu)	0.009	0.009
Germanium (Ge)	ND	ND
Iron (Fe)	0.006	0.017
Lead (Pb)	ND	ND
Magnesium (Mg)	43	44
Manganese (Mn)	0.008	0.009
Molybdenum (Mo)	ND	ND
Nickel (Ni)	0.007	0.007
Potassium (K)	0.96	1.7
Silica (Si)	0.66	0.13
Silver (Ag)	<0.004	<0.002
Sodium (Na)	18	40
Strontium (Sr)	9.0	9.2
Tellurium (Te)	ND	ND
Tin (Sn)	ND	ND
Titanium (Ti)	0.005 ¹	<0.002
Vanadium (V)	ND	ND
Tungsten (W)	ND	ND
Zirconium	ND	ND

ND = Not Detected

¹The result for this analysis may represent lab error.

Table 3-8-60. Means of water quality data (pesticides) for RBOSP Aquatic Baseline Studies, April 1975. (Means are expressed in mg/l.)¹

Parameter	Station	
	25	34
Lindane	<0.0001	<0.0001
Malathion	<0.0005	<0.0005
Parathion	<0.0001	<0.0001
Toxaphene	<0.002	<0.002

¹Results of all analyses were less than detection limit.

Table 3-8-61. Means of water quality data (pesticides) for RBOSP Aquatic Baseline Studies, August - September 1975. (Means are expressed in mg/l.)¹

Parameter	Station	
	25	34
Lindane	<0.0001	<0.0001
Malathion	<0.0005	<0.0005
Parathion	<0.0001	<0.0001
Toxaphene	<0.002	<0.002

¹Results of all analyses were less than detection limit.

During the study period, the concentration of water quality parameters did not generally vary appreciably between sampling locations, but the concentrations of certain parameters did vary among sampling dates. The concentrations of fluoride varied only slightly between stations but varied considerably between the April 1975 sampling and the May-June 1975 sampling. The concentrations of carbon compounds, fluoride, mercury, organic nitrogen, and oils were highest during April 1975 and lowest during May-June 1975. Fecal coliform densities were also highest in April. The high concentrations of fecal coliform bacteria and of certain chemical parameters during April 1975 may be attributed to local thawing and runoff.

5. Discussion - In evaluating the existing water quality of the White River near its confluence with Yellow Creek, the standards of both the Colorado Water Quality Control Commission (1974) and the U. S. Public Health Service (1962) were used. Table 3-8-62 lists both the maximum allowable and recommended limiting concentrations of chemical parameters for public drinking water. The recommended limiting concentrations are those which should not be exceeded when more suitable supplies can be made available. These recommended limiting concentrations are based primarily upon taste and odor considerations, whereas the maximum allowable limits are based on the toxicity of the constituents to humans.

During the period of study, none of the levels observed exceeded the maximum allowable limits or recommended limiting concentrations of the U.S. Public Health Service (1962). Levels of gross beta radioactivity in samples from the White River were well below the maximum allowable U.S. Public Health Service limit of 1,000 pCi/l.

Fecal coliform counts were significantly lower than the standards of the Colorado Water Control Commission (1974) for Class B₂ waters.

Table 3-8-62. Maximum allowable and recommended limiting concentrations for chemical parameters in drinking water (from United States Public Health Service Drinking Water Standards, 1962.)

	Recommended Concentrations (mg/l)	Maximum Allowable Concentrations (mg/l)
Arsenic (As), Diss	0.01	0.05
Barium (Ba), Diss		1.0
Cadmium (Cd), Diss		0.01
Copper (Cu), Diss	1	
Cyanide (Cn), Total	0.01	0.2
Fluoride (F), Diss	0.8 - 1.7	1.7
Iron (Fe), Total Diss	0.3	
Lead (Pb), Diss		0.05
Manganese (Mn), Diss	0.05	
Selenium (Se), Diss		0.01
Sulfate (S), Diss	250.00	
Zinc (Zn), Diss	5	

Diss = Dissolved

Source: United States Public Health Service (1962)

Limits are based upon annual average of maximum daily air temperatures.

E. Springs and Seepages

1. Objectives - The objective of this aspect of the RBOSP Aquatic Baseline Studies is to identify and record the locations of springs and seeps on Tract C-a as they are encountered during routine aquatic sampling.

2. Methods - During routine aquatic sampling, the locations of springs and seeps were noted and recorded as they were encountered.

3. Data Summary and Discussion - The locations of springs and seeps on Tract C-a are identified in Chapter 4 of Section 3.

8.2 BIOTIC

A. Phytoplankton

1. Objectives - The objectives of phytoplankton studies are to determine the species composition and abundance of the phytoplankton as an aid in characterizing the aquatic habitats on and near Tract C-a.

2. Methods - At each station, duplicate samples were collected with pump-type samplers concurrently with water chemistry samples. Phytoplankton samples were transferred to opaque bottles containing premeasured quantities of Lugol's preservative. These samples were then stored in the dark until processing.

In the laboratory, preserved phytoplankton samples were prepared for study using a modification of the membrane filter concentration technique of APHA (1971). Based on preliminary work, an aliquot size of 100 ml was chosen to produce a preparation that would have densities of organisms optimal for taxonomy and enumeration. This 100 ml aliquot was filtered through a cellulose acetate membrane (Millipore) filter of 0.45-micron pore size. The following series of stains and dehydrations was then performed on the filtered sample in situ (Northern States Power Co., 1974).

- water rinse
- acid fuchsin stain (aqueous)
- water rinse
- 50% isopropanol
- 90% isopropanol
- 100% isopropanol (2 washes)
- xylene (2 rinses)

The filter was allowed to soak in the final xylene rinse for 15 minutes, was trimmed and mounted on a microscope slide with several drops of Permunt, and was then covered with an ultrathin coverglass. The slides were labeled and retained in a permanent voucher collection.

Quantitative counts were made using two transects that cross near the center of the mounted Millipore filter. All organisms within these fields were identified and counted at 1000X. Identifications were aided by using the data from live samples and by using species lists prepared from Hyrax preparations of cleaned diatoms (see below). Finally, large organisms that were too uncommon to be observed in high numbers in the counted strips were identified and counted during a 100X scan of the entire slide. Counts were expressed as cells per ml of the original sample. When colonies containing vast numbers of cells were encountered (as with certain colonial blue-green algae), ten colonies were counted and cell numbers determined from the mean number of cells per colony.

For the study of diatoms, additional subsamples were specially treated according to the method of Patrick and Reimer (1966). The organic contents of the cells, as well as organic detrital matter in the samples, were removed by oxidation in boiling nitric acid or by ashing. The empty diatom frustules were washed and dehydrated with alcohol, then washed with xylene and mounted in Hyrax. These slides were used to aid in the taxonomy of certain diatoms and also serve as vouchers. The pertinent taxonomic references used for phytoplankton identification were Cleve-Euler (1951), Drouet (1968), Gojdics (1953), Hustedt (1930), Prescott (1962), Van Huerch (1896) and West and West (1908).

3. Literature Review - The term phytoplankton refers to the plant portion of the community of free-floating aquatic microorganisms. Because, in general, planktonic organisms play a relatively minor role in flowing waters, there have been few studies of planktonic communities of small streams and rivers, such as those in the vicinity of Tract C-a. This review of literature includes both general references and, where possible, references to phytoplankton studies of Colorado streams.

Hynes (1970) notes that no planktonic organisms are found exclusively in rivers or streams. Thus, according to Hynes, most river plankters must originate in still or gently flowing waters, and must be constantly, or frequently, supplied to the river, where they may or may not reproduce in

significant numbers. Ruttner (1965) suggests that the development of a true river plankton depends in large measure on the reproduction rate of the species present. That is, with a rapid rate of reproduction, plankton may develop sizable populations even in relatively short streams.

According to Butcher (1932), the composition of the phytoplankton of streams and rivers is determined by the nature of the source of the plankton. The potential sources of phytoplankton in a stream include the algae of pools, lakes, drains, and tributaries and the algae on the stream-bed. Butcher indicates that the sessile algae are an important source of phytoplankton in rivers, and that sessile algae are probably the most important source in small streams. Generally, phytoplankton derived from lake-like enlargements in the river or from pools within the watershed are characteristic species whose origin is readily recognized. Tributaries, ditches, and drains also contribute phytoplankton to rivers and streams; the algal species derived from such sources are often the same as those derived from the quieter river channels and backwater areas. According to Butcher (1932), the phytoplankton of rivers and streams is generally composed of diatoms and small green and blue-green algae.

Prescott (1968) suggests that the phytoplankton of streams varies with the chemical condition of the water, temperature and the amount of suspended matter and that there is virtually no plankton in rapidly flowing, spring-fed streams (particularly near the headwaters). Prescott reports that the phytoplankton found in the lower reaches of a stream include: 1) transient species which originate in lakes, swamps and marshes in the headwaters and do not complete their life histories; 2) species which normally occur in streams and which do complete their life histories, and 3) species (particularly diatoms) which are forced to enter the stream, can adjust to stream conditions, and can multiply in transit.

Pennak (1943) found that few phytoplankton species occurred in Boulder Creek near Boulder, Colorado. He reports that diatoms were always the dominant plankters. He found both truly planktonic forms such as Asterionella, Melosira, and Synedra, and sessile species of Navicula, Stauroneis, Diatoma

and Gomphonema. Pennak suggests that the phytoplankton maximum observed between April and August was due to greater growth during the warmer months and the fact that spring runoff washed away substantial numbers of attached forms.

Hynes (1970) indicates that the plankton of headwater streams contains representatives of the benthic algae, primarily diatoms, which have been washed away from the stream bed. In addition, some streams may contain truly planktonic algae, such as Asterionella, Fragilaria and Melosira, which presumably stray from other bodies of water draining into the streams. Hynes suggests that, generally, the quantity of plankton increases as one proceeds downstream. However, this depends upon local conditions, since the area encompassed by pools and riffles varies greatly from stream to stream and the production of phytoplankton is greater in the pool areas. Phytoplankton occurrence and abundance also varies with the season, because warmer waters encourage maximum phytoplankton development, and on the incidence of floods. Hynes also states that phytoplankton is always more abundant in rivers than is zooplankton and that the diatoms are nearly always the dominant group of phytoplankton.

In their studies of Huntington Creek, Utah (a clear, cold, fast flowing calcareous stream), Squires, Rushforth, and Endsley (1973) reported that diatoms were the most abundant algal group in the periphyton and phytoplankton. They indicated that benthic diatoms were the major contributors to the nanoplankton portion of the phytoplankton and that seasonal periphyton fluctuations were generally correlated with similar fluctuations in the phytoplankton. The authors reported that the major factors determining fluctuations in nanoplankton abundance were water level fluctuations, water temperature changes and mechanical disturbances.

4. Data Summary

a. Headwaters - Tables 3-8-63 through 3-8-68 summarize the densities of the most abundant phytoplankton taxa at the Headwater stations for each sampling period between October - November 1974 and August - September 1975.

Table 3-8-63. Summary of means of densities of the most abundant phytoplankton at the Headwater Stations during RBOSP Aquatic Baseline Studies, October - November 1974. (Data are expressed as the mean number of cells/ml.)

	Station				
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
CYANOPHYTA					
<u>Oscillatoria tenuis</u>		6	12		
<u>Schizothrix calcicola</u>	8	16	5		
CHLOROPHYTA					
Chlorophyte (unidentified)		4	16	24	7
CHRYSOPHYTA					
<u>Diatoma vulgare</u>		2	89	3	1
<u>Fragilaria construens</u>			50		
<u>Achnanthes minutissima</u>	30	34	56	42	11
<u>Anomoeneis sphaerophora</u>			65		
<u>Navicula cryptocephala</u>			54		
<u>Navicula salinarum</u>				214	
<u>Navicula viridula</u>			51		
<u>Pinnularia brebissonii</u>			48		3
<u>Nitzschia frustulum</u>		10	55		
<u>Nitzschia linearis</u>			40		
<u>Surirella ovalis</u>			38		
<u>Synedra amphicephala</u>		19			31

Table 3-8-64. Summary of means of densities of the most abundant phytoplankton at the Headwater Station during RBOSP Aquatic Baseline Studies, December 1974 - January 1975.¹ (Data are expressed as the mean number of cells/ml.)

	Station		
	3	4	5
CYANOPHYTA			
<u>Merismopedia tenuissima</u>		33	
<u>Gomphosphaeria lacustris</u>		65	
CHLOROPHYTA			
Chlorophyta I	16	34	8
CHRY SOPHYTA			
<u>Chrysidiastrium ocellatum</u>		63	2
<u>Meridion circulare</u>		76	1
<u>Fragilaria crotonensis</u>		77	
<u>Synedra amphicephala</u>		25	10
<u>Achnanthes lanceolata</u>		36	5
<u>Achnanthes minutissima</u>	31	558	49
<u>Nitzschia frustulum</u>	29	4	5
<u>Nitzschia linearis</u>	1	791	4
<u>Surirella ovata</u>		38	1
CRYPTOPHYTA			
<u>Rhodomonas minuta</u>	4	11	17

¹Stations 1 and 2 were inaccessible.

Table 3-8-65. Summary of means of densities of the most abundant algal taxa observed in the phytoplankton at the Headwater Stations during RBOSP Aquatic Baseline Studies, April 1975. (Data are expressed in number of cells/ml).

	Station				
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
CYANOPHYTA					
Cyanophyta I			124		
<u>Oscillatoria tenuis</u>		151			
CHLOROPHYTA					
<u>Ulothrix subtilissima</u>	327	49			
<u>Dictyosphaerium pulchellum</u>					
Chlorophyta I	69	73	205	86	135
Flagellate (unidentified)	38	159	105	227	160
CHRYSTOPHYTA					
<u>Chrysidiastrium ocellatum</u>				346	
<u>Microsiphona potamos</u>					
<u>Thalassiosira fluviatilis</u>					
<u>Cyclotella meneghiniana</u>					
<u>Diatoma vulgare</u>					
<u>Fragilaria pinnata</u>					
<u>Fragilaria vaucheriae</u>		15	32		11
<u>Synedra amphicephala</u>	3		22		135

Table 3-8-65. Continued.

	Station				
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
CHRYSTOPHYTA (Cont.)					
<u>Cocconeis pediculus</u>					
<u>Achnanthes lanceolata</u>		47		34	14
<u>Achnanthes minutissima</u>	95	116	178	205	62
<u>Navicula arvensis</u>	6	2	67		35
<u>Navicula cryptocephala</u>	16	4	116	76	27
<u>Navicula pelliculosa</u>	16	3	321	22	63
<u>Navicula salinarum</u>					
<u>Navicula tripunctata</u>					
<u>Navicula viridula</u>					
<u>Cymbella affinis</u>					
<u>Gomphonema intricatum</u>	11		27		273
<u>Gomphonema olivaceum</u>					
<u>Gomphonema ventricosum</u>					
<u>Amphiprora alata</u>					
<u>Nitzschia frustulum</u>	8	3	168	11	97
<u>Nitzschia palea</u>					
<u>Surirella ovata</u>					
<u>Surirella ovalis</u>					
CRYPTOPHYTA					
<u>Rhodomonas minuta</u>					

Table 3-8-66. Summary of means of densities of the most abundant algal taxa observed in the phytoplankton at the Headwater Stations during RBOSP Aquatic Baseline Studies, May - June 1975. (Data are expressed in number of cells/ml).

	Station				
	1	2	3	4	5
CYANOPHYTA					
Cyanophyta I			138	146	
Cyanophyta II			43		
<u>Chroococcus disperus</u>					97
CHLOROPHYTA					
<u>Carteria dissecta</u>					61
<u>Ulothrix subtilissima</u>		52			
Chlorophyta I	39	12	249	147	53
Chlorophyta II					
Flagellate unidentified	32	17	172	46	80
CHRYSTOPHYTA					
<u>Bicoeca lacustris</u>					
<u>Thalassiosira fluviatilis</u>					
<u>Cyclotella meneghiniana</u>					
<u>Stephanodiscus astraea</u>					
<u>Stephanodiscus tenuis</u>					
<u>Fragilaria pinnata</u>					
<u>Synedra pulchella</u>					
<u>Achnanthes lanceolata</u>					

Table 3-8-66. Continued.

CHRYSTOPHYTA (Cont.)	Stations				
	1	2	3	4	5
<u>Achnanthes minutissima</u>	88	57	76	43	266
<u>Navicula arvensis</u>	80		21	2	
<u>Navicula cryptocephala</u>	22		89	23	12
<u>Navicula gregaria</u>	61				
<u>Navicula pelliculosa</u>	8	12	92	37	3
<u>Navicula salinarum</u>					
<u>Navicula viridula</u>					
<u>Cymbella affinis</u>					
<u>Cymbella cistula</u>					
<u>Cymbella sinuata</u>					
<u>Cymbella ventricosa</u>					
<u>Amphiprora alata</u>					
<u>Nitzschia acicularis</u>					
<u>Nitzschia denticula</u>					
<u>Nitzschia frustulum</u>	4	4	173	37	8
<u>Nitzschia linearis</u>			35	7	11
<u>Nitzschia palea</u>	241	2	191	12	3

Table 3-8-67. Summary of means of densities of the most abundant algal taxa observed in the phytoplankton at the Headwater Stations during RBOSP Aquatic Baseline Studies, July - August 1975. (Data are expressed in number of cells/ml).

CYANOPHYTA	Station				
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
Cyanophyta I	330		138		
<u>Chroococcus limneticus</u>					
<u>Schizothrix calcicola</u>					
CHLOROPHYTA					
Chlorophyta I	61	6	20	10	19
Flagellate unidentified	105	30	54	118	58
CHRYSTOPHYTA					
Bicoeca lacustris	95				
<u>Thalassiosira fluviatilis</u>					
<u>Cyclotella meneghiniana</u>					
<u>Diatoma vulgare</u>					
<u>Fragilaria crotonensis</u>					
<u>Fragilaria leptostauron</u>					
<u>Fragilaria pinnata</u>					
<u>Fragilaria vaucheriae</u>					
<u>Synedra amphicephala</u>					
<u>Synedra ulna</u>					
<u>Cocconeis pediculus</u>	199	104	51	131	6
<u>Achnanthes minutissima</u>	2		66		2
<u>Anomoeoneis sphaerophora</u>	152		4	21	
<u>Navicula arvensis</u>	84	5	399	81	5
<u>Navicula cryptocephala</u>					

Table 3-8-67. Continued.

CHRYSTOPHYTA (Cont.)	Station				
	1	2	3	4	5
<u>Navicula pelliculosa</u>	31	5	3	21	
<u>Navicula salinarum</u>	2	2	29	54	
<u>Navicula viridula</u>	8	2	92		2
<u>Amphora ovalis</u> var. <u>pediculus</u>					
<u>Cymbella affinis</u>					
<u>Cymbella ventricosa</u>					
<u>Gomphonema olivaceum</u>					
<u>Nitzschia acicularis</u>					
<u>Nitzschia capitellata</u>					
<u>Nitzschia denticula</u>					
<u>Nitzschia fonticola</u>					
<u>Nitzschia frustulum</u>	34	6	48	37	13
<u>Nitzschia holsatica</u>					
<u>Nitzschia linearis</u>		1	8	50	
<u>Nitzschia palea</u>	76		64	98	
CRYPTOPHYTA					
<u>Cryptomonas erosa</u>					

Table 3-8-68. Summary of means of densities of the most abundant algal taxa observed in the phytoplankton at the Headwater Stations during RBOSP Aquatic Baseline Studies, August - September 1975. (Data are expressed as the mean number of cells/ml.)

	Station				
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
CHLOROPHYTA					
<u>Ulothrix subtilissima</u>	48	4			
<u>Chlorophyta I</u>			62		17
<u>Flagellate (unidentified)</u>	69	20	124	4	40
CHRYSTOPHYTA					
<u>Synedra minuscula</u>	214	9		3	
<u>Cocconeis pediculus</u>					230
<u>Achnanthes minutissima</u>	671	11	81	53	16
<u>Anomoeoneis sphaerophora</u>			287		
<u>Navicula arvensis</u>	697	2	6		
<u>Navicula cryptocephala</u>	25	7	364	189	11
<u>Navicula sp. 2</u>	-	1	170	24	
<u>Cymbella affinis</u>	51			1	
<u>Nitzschia denticula</u>	331		43	8	
<u>Nitzschia frustulum</u>		3	60	5	2
<u>Nitzschia palea</u>	7	3	192	36	10
EUGLENOPHYTA					
<u>Euglena spp.</u>			95		

A total of 163 algal taxa were observed in the phytoplankton of the Headwater stations during the one-year period; Table 3-8-69 lists the algal taxa observed at the Headwater stations. Figure 3-8-16 indicates the seasonal variation in abundance for the algal groups present in the phytoplankton at the Headwater stations.

During the October - November 1974 sampling period, phytoplankton abundance was quite low in samples from the Headwater stations. The most abundant (dominant) algal group was Chrysophyta (primarily diatoms). The most abundant species included the diatoms Achnanthes minutissima, Navicula salinarum and Diatoma vulgare.

Increased phytoplankton abundance was observed in collections made during the December 1974 - January 1975 sampling. The most abundant algal groups was Chrysophyta and the most abundant taxa included the diatoms Achnanthes minutissima, Fragilaria crotonensis, Meridion circulare, Nitzschia linearis and N. frustulum; Chrysidiastrium ocellatum, a species belonging to the Chrysophyceae, and Gomphosphaeria lacustris, a blue-green alga, were also present.

Still greater phytoplankton abundance was found in samples collected during April 1975. The most abundant algal groups were Chrysophyta and Chlorophyta (green algae). The most abundant taxa included the blue-green alga Oscillatoria tenuis; the green algae Ulothrix subtilissima, an unidentified flagellate, and Closterium venus; the diatoms Achnanthes minutissima, Gomphonema intricatum, Navicula arvensis, N. cryptocephala, N. pelliculosa and Nitzschia frustulum; and the chrysophyte Chrysidiastrium ocellatum.

During May-June 1975, phytoplankton abundance was somewhat lower than during April. The most abundant algal groups in the phytoplankton were Chlorophyta and Chrysophyta. The most abundant species included the blue-green Chroococcus dispersus and an unidentified species; the diatoms Achnanthes minutissima, Navicula cryptocephala, N. pelliculosa, Nitzschia frustulum and N. palea; an unidentifiable chlorophyte and an unidentified flagellate.

Table 3-8-69. Algal taxa observed in the phytoplankton at the Headwater Stations during RBOSP Aquatic Baseline Studies between October-November 1974 and August-September 1975.

CYANOPHYTA

Cyanophyta I
Cyanophyta II
Chroococcus dispersus
Chroococcus limneticus
Aphanocapsa elachista
Merismopedia tenuissima
Gomphosphaeria lacustris
Oscillatoria limosa
Oscillatoria tenuis
Oscillatoria spp.
Schizothrix calcicola
Anabaena spp.
Plectonema spp.
Calothrix epiphytica
Calothrix spp.

CHLOROPHYTA

Chlamydomonas globosa
Chlamydomonas snowii
Carteria dissecta
Sphaerocystis Schroeteri
Ulothrix subtilissima
Ulothrix zonata
Ulothrix spp.
Stigeoclonium spp.
Cladophora fracta
Cladophora spp.
Pediastrum simplex var. duodenarium
Coelastrum microporum
Lagerheimia ciliata
Ankistrodesmus convolutus
Ankistrodesmus falcatus
Quadrigula chodatii
Scenedesmus quadricauda
Crucigenia quadrata
Crucigenia tetrapedia
Spirogyra spp.
Zygnema spp.
Closterium leibleinii
Closterium parvulum
Closterium spp.
Cosmarium spp.

Table 3-8-69. Continued.

Chlorophyta 1
Flagellate 1

CHRYSTOPHYTA

Chrysophyta 1
Bicoeca lacustris
Chrysidiastrium catenatum
Chrysidiastrium ocellatum
Melosira granulata
Thalassiosira fluviatilis
Cyclotella meneghiniana
Stephanodiscus tenuis
Diatoma hiemale
Diatoma tenue var. elongatum
Diatoma vulgare
Meridion circulare
Fragilaria capucina
Fragilaria construens
Fragilaria crotonensis
Fragilaria pinnata
Fragilaria vaucheriae
Hannaea arcus
Synedra amphicephala
Synedra famelica
Synedra minuscula
Synedra nana
Synedra pulchella
Synedra ulna
Asterionella formosa
Cocconeis pediculus
Cocconeis placentula
Achnanthes lanceolata
Achnanthes minutissima
Rhoicosphenia curvata
Mastogloia elliptica
Gyrosigma acuminatum
Pleurosigma delicatulum
Stauroneis phoenicenteron
Stauroneis smithii
Anomoeoneis sphaerophora
Diploneis elliptica
Navicula arvensis
Navicula cryptocephala
Navicula cuspidata
Navicula decussis
Navicula fragilarioides

Table 3-8-69. Continued.

Navicula gregaria
Navicula minima
Navicula mutica
Navicula pelliculosa
Navicula pupula
Navicula pygmaea
Navicula radiosa
Navicula rhyncocephala
Navicula salinarum
Navicula tripunctata
Navicula viridula
Navicula spp.
Navicula sp. 1
Navicula sp. 2
Navicula sp. 5
Navicula sp. 6
Caloneis amphisbaena
Caloneis bacillum
Caloneis sphaerophora
Caloneis ventricosa
Pinnularia abaujensis
Pinnularia brebissonii
Pinnularia globiceps
Pinnularia subcapitata
Pinnularia viridis
Pinnularia spp.
Amphora montana
Amphora ovalis
Amphora ovalis var. pediculus
Cymbella aequalis
Cymbella affinis
Cymbella microcephala
Cymbella naviculiformis
Cymbella obtuscula
Cymbella tumida
Cymbella turgida
Cymbella ventricosa
Gomphonema angustatum
Gomphonema intricatum
Gomphonema olivaceum
Gomphonema parvulum
Gomphonema ventricosum
Gomphonema spp.
Epithemia sorex
Epithemia turgida
Epithemia zebra
Rhopalodia gibba

Table 3-8-69. Continued.

Cylindrotheca gracilis
Hantzschia amphioxys
Nitzschia acicularis
Nitzschia apiculata
Nitzschia capitata
Nitzschia capitellata
Nitzschia chasei
Nitzschia denticula
Nitzschia dissipata
Nitzschia fonticola
Nitzschia frustulum
Nitzschia gracilis
Nitzschia holsatica
Nitzschia linearis
Nitzschia palea
Nitzschia sigma
Nitzschia sigmoidea
Nitzschia vermicularis
Cymatopleura solea
Surirella angustata
Surirella ovata
Surirella ovalis
Surirella spp.
Campylodiscus hibernicus

EUGLENOPHYTA

Euglena proxima
Euglena spp.
Trachelomonas hispida
Trachelomonas pulchella
Trachelomonas volvocina

PYRRHOPHYTA

Peridinium spp.
Ceratium hirundinella

CRYPTOPHYTA

Cryptomonas erosa
Cryptomonas ovata
Rhodomonas minuta

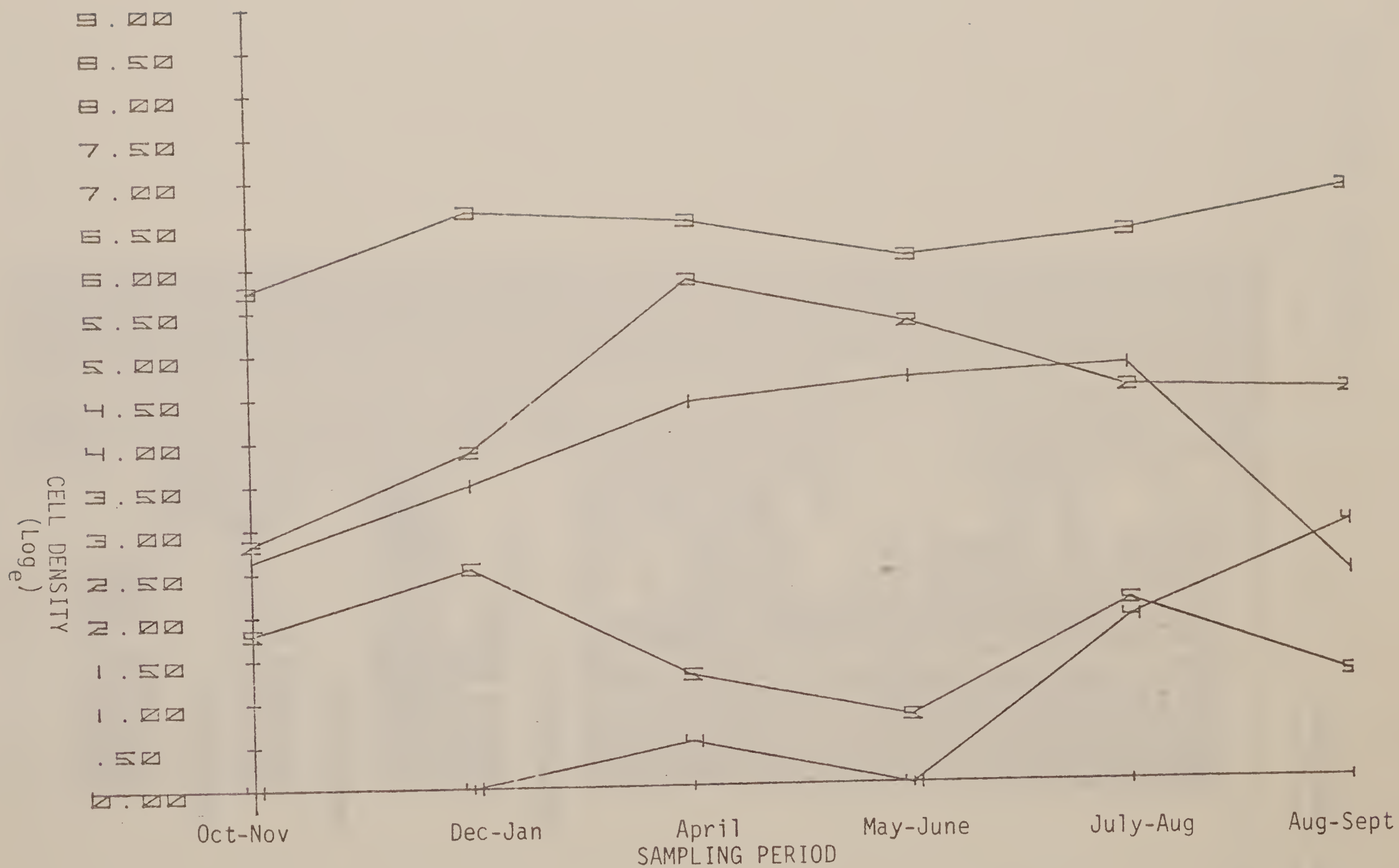


Figure 3-8-16. Log mean densities of the major algal groups in the phytoplankton at the Headwater Stations during RBOSP Aquatic Baseline Studies from October - November 1974 to August - September 1975. (Cyanophyta = 1; Chlorophyta = 2; Chrysophyta = 3; Euglenophyta = 4; Pyrrhophyta = 5; and Cryptophyta = 6)

Chrysophyta and Cyanophyta were the most abundant algal groups in the phytoplankton of the Headwater stations during July - August 1975. The most abundant species included the diatoms Achnanthes minutissima, Navicula cryptocephala, N. arvensis, N. viridula, Nitzschia fonticola and N. palea; and unidentified green flagellate and an unidentified blue-green alga were also abundant.

The August - September 1975 phytoplankton collections from Headwater Station 1 were dominated by Navicula arvensis, Achnanthes minutissima, Nitzschia denticula and Synedra minuscula. Phytoplankton abundance was low at Station 2; the most abundant taxa were several unidentifiable flagellates, Achnanthes minutissima, and Synedra minuscula. The most abundant algal taxa at Stations 3 and 4 were Navicula cryptocephala, Nitzschia palea, Anomoeoneis sphaerophora, Navicula sp.2, Achnanthes minutissima and several unidentifiable flagellates. At Station 5, Cocconeis pediculus was the most abundant algal taxon; other abundant taxa included Achnanthes minutissima, several unidentifiable flagellates and several single-celled green algae (Chlorophyta I).

b. Tract C-a - Tables 3-8-70 through 3-8-75 include the mean densities of the most abundant phytoplankton taxa in the tract region for each sampling period from October - November 1974 to August - September 1975. During the one year of study, a total of 156 algal taxa were recorded at the Tract stations. Table 3-8-76 lists the alga taxa observed in the phytoplankton at the Tract stations. Figure 3-8-17 indicates the seasonal variation in the abundance of algal groups encountered at the Tract stations.

During the October - November 1974 sampling, phytoplankton abundance was low at the Tract stations. The most abundant algal group during this period was Chrysophyta. The most abundant species included the diatoms Achnanthes minutissima, A. lanceolata and Navicula tripunctata; the chrysophyte Chrysidiastrium ocellatum; the blue-green alga Merismopedia glauca; and unidentified green algal species.

Table 3-8-70. Summary of means of densities of the most abundant algal taxa observed in the phytoplankton at the Tract Stations during RBOSP Aquatic Baseline Studies, October - November 1974. (Data are expressed in number of cells/ml).

CYANOPHYTA	Station					
	6	7	8	9	13	14
<u>Chroococcus limneticus</u>		15	11	11	11	33
<u>Merismopedia glauca</u>				32	11	64
<u>Merismopedia tenuissima</u>						
<u>Oscillatoria tenuis</u>						
<u>Schizothrix calcicola</u>						
CHLOROPHYTA						
<u>Spirogyra spp.</u>		46		1		11
<u>Zygnema spp.</u>		78		1		21
<u>Chlorophyta I</u>		56	32		15	19
CHRYSTOPHYTA						
<u>Chrysidiastrium ocellatum</u>			221			
<u>Cyclotella meneghiniana</u>						
<u>Diatoma vulgare</u>						
<u>Fragilaria crotonensis</u>				47	4	3
<u>Fragilaria pinnata</u>						
<u>Synedra amphicephala</u>				4	28	55
<u>Synedra ulna</u>						
<u>Cocconeis pediculus</u>						
<u>Cocconeis placentula</u>						
<u>Achnanthes lanceolata</u>		15	91	4	25	4
<u>Achnanthes minutissima</u>		921	69	180	132	490
<u>Anomoeoneis sphaerophora</u>						
<u>Navicula cryptocephala</u>						

¹ Stations 6, 10-12 and 15-18 were dry at the time of sampling.

Table 3-8-70. Continued.

CHRYSTOPHYTA (Cont.)	Station					
	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>13</u>	<u>14</u>
<u>Navicula salinarum</u>		8	1	4	248	11
<u>Navicula tripunctata</u>						
<u>Navicula viridula</u>						
<u>Pinnularia brebissonii</u>						
<u>Cymbella affinis</u>		5	1	96		
<u>Gomphonema intricatum</u>						
<u>Gomphonema olivaceum</u>						
<u>Gomphonema ventricosum</u>						
<u>Epithemia sorex</u>		3	1	1		57
<u>Nitzschia frustulum</u>		9	5	1	40	42
<u>Nitzschia linearis</u>						
<u>Nitzschia palea</u>						
<u>Surirella ovata</u>						
<u>Surirella ovalis</u>						
CRYPTOPHYTA						
<u>Rhodomonas minuta</u>						

Table 3-8-71. Summary of means of densities of the most abundant algal taxa observed in the phytoplankton at the Tract Stations during RBOSP Aquatic Baseline Studies, December 1974 - January 1975. (Data are expressed in number of cells/ml).¹

	Stations				
	<u>8</u>	<u>9</u>	<u>13</u>	<u>14</u>	<u>19</u>
CYANOPHYTA					
<u>Merismopedia tenuissima</u>					
<u>Gomphosphaeria lacustris</u>					
CHLOROPHYTA					
<u>Oedogonium spp.</u>					
<u>Micractinium pusillum</u>					
CHRYSTOPHYTA					
<u>Bicoeca lacustris</u>	77	32	.2	5	18
<u>Chrysidiastrum ocellatum</u>	2025	237			
<u>Cyclotella meneghiniana</u>					
<u>Diatoma vulgare</u>	14	8	4		
<u>Meridion circulare</u>					
<u>Fragilaria crotonensis</u>					
<u>Fragilaria vaucheriae</u>					
<u>Synedra amphicephala</u>					
<u>Synedra pulchella</u>					
<u>Synedra ulna</u>	2	9		8	1
<u>Cocconeis pediculus</u>					
<u>Achnanthes lanceolata</u>	15		5	5	
<u>Achnanthes minutissima</u>	301	220	120	31	8

¹ Stations 6, 7, 10-12 and 15-18 were dry, ice covered, or frozen solid during time of sampling.

Table 3-8-71. Continued.

	Stations				
	<u>8</u>	<u>9</u>	<u>13</u>	<u>14</u>	<u>19</u>
CHRYSTOPHYTA (Cont.)					
<u>Navicula cryptocephala</u>					
<u>Navicula salinarum</u>	5	10	367	4	10
<u>Navicula tripunctata</u>					
<u>Cymbella affinis</u>	7	7	3	24	1
<u>Gomphonema intricatum</u>	12		4	1	1
<u>Gomphonema olivaceum</u>	7	5	7	1	2
<u>Gomphonema ventricosum</u>					
<u>Epithemia sorex</u>	3	10		4	1
<u>Nitzschia dissipata</u>					
<u>Nitzschia frustulum</u>	6	4	12	4	18
<u>Nitzschia linearis</u>	8	47	27	5	1
<u>Nitzschia palea</u>					
<u>Surirella ovata</u>					
CRYPTOPHYTA					
<u>Rhodomonas minuta</u>	18	18	2	2	4

Table 3-8-72, Summary of means of densities of the most abundant algal taxa observed in the phytoplankton at the Tract Stations during RBOSP Aquatic Baseline Studies, April 1975. (Data are expressed in number of cells/ml).¹

	Station				
	<u>7</u>	<u>8</u>	<u>9</u>	<u>13</u>	<u>14</u>
CYANOPHYTA					
Cyanophyta I	281	22	22	270	103
<u>Oscillatoria tenuis</u>					
CHLOROPHYTA					
<u>Ulothrix subtilissima</u>					
<u>Dictyosphaerium pulchellum</u>			259		
Chlorophyta I	198	61	173	249	200
Flagellate (unidentified)	81	61	249		82
CHRY SOPHYTA					
<u>Chrysidiastrium ocellatum</u>		125	826		
<u>Microsiphona potamos</u>					384
<u>Thalassiosira fluviatilis</u>					
<u>Cyclotella meneghiniana</u>					
<u>Diatoma vulgare</u>					
<u>Fragilaria pinnata</u>					
<u>Fragilaria vaucheriae</u>					
<u>Synedra amphicephala</u>					

¹ Stations 6, 10-12 and 15-18 were dry at the time of sampling.

Table 3-8-72. Continued.

	Station				
	<u>7</u>	<u>8</u>	<u>9</u>	<u>13</u>	<u>14</u>
CHRYSTOPHYTA (Cont.)					
<u>Cocconeis pediculus</u>					
<u>Achnanthes lanceolata</u>					
<u>Achnanthes minutissima</u>	589	265	343	441	251
<u>Navicula arvensis</u>	19	2			462
<u>Navicula cryptocephala</u>	97	8	11	350	249
<u>Navicula pelliculosa</u>	160	22	116	19	622
<u>Navicula salinarum</u>	8		6	257	116
<u>Navicula tripunctata</u>					
<u>Navicula viridula</u>					
<u>Cymbella affinis</u>					
<u>Gomphonema intricatum</u>					
<u>Gomphonema olivaceum</u>					
<u>Gomphonema ventricosum</u>		3		307	
<u>Amphiprora alata</u>					
<u>Nitzschia frustulum</u>		3			154
<u>Nitzschia palea</u>					
<u>Surirella ovata</u>	11	4	3	123	19
<u>Surirella ovalis</u>					
CRYPTOPHYTA					
<u>Rhodomonas minuta</u>					

Table 3-8-73. Summary of means of densities of the most abundant algal taxa observed in the phytoplankton at the Tract Stations during RBOSP Aquatic Baseline Studies, May - June 1975. (Data are expressed in number of cells/ml).

	Station					
	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>13</u>	<u>14</u>
CYANOPHYTA						
Cyanophyta I	486		178	103		
Cyanophyta II	502					
<u>Chroococcus dispersus</u>	292	194	103	486		235
CHLOROPHYTA						
<u>Carteria dissecta</u>						
<u>Ulothrix subtilissima</u>						
Chlorophyta I	79	184	102	203	15	51
Chlorophyta II						
Flagellate (unidentified)	24	62	14	70	8	53
CHRYSTOPHYTA						
<u>Bicoeca lacustris</u>	262		57			
<u>Thalassiosira fluviatilis</u>						
<u>Cyclotella meneghiniana</u>						
<u>Stephanodiscus astraea</u>						
<u>Stephanodiscus tenuis</u>						
<u>Fragilaria pinnata</u>						
<u>Synedra pulchella</u>						
<u>Achnanthes lanceolata</u>						

¹ Stations 10-12 and 15-18 were dry at the time of sampling.

Table 3-8-73. Continued.

CHRYSTOPHYTA (Cont.)	Station:					
	6	7	8	9	13	14
<u>Achnanthes minutissima</u>	392	424	125	402	31	160
<u>Navicula arvensis</u>						
<u>Navicula cryptocephala</u>	68	111	19	76	6	18
<u>Navicula gregaria</u>						
<u>Navicula pelliculosa</u>	8	46	13	62	2	2
<u>Navicula salinarum</u>	14	81		19	4	
<u>Navicula viridula</u>						
<u>Cymbella affinis</u>	22	14		38	1	50
<u>Cymbella cistula</u>						
<u>Cymbella sinuata</u>						
<u>Cymbella ventricosa</u>						
<u>Amphiprora alata</u>						
<u>Nitzschia acicularis</u>						
<u>Nitzschia denticula</u>	5	54		265	2	170
<u>Nitzschia frustulum</u>	19	138	14	265	9	22
<u>Nitzschia linearis</u>	5	111		54	1	
<u>Nitzschia palea</u>	5	70	8	154		2

Table 3-8-74. Summary of means of densities of the most abundant algal taxa observed in the phytoplankton at the Tract Stations during RBOSP Aquatic Baseline Studies, July - August 1975. (Data are expressed in number of cells/ml).

	Station							
	7	8	9	13	14	15	17	18
CYANOPHYTA								
Cyanophyta I	11		219		8	36	132	
<u>Chroococcus limneticus</u>			249					
<u>Schizothrix calcicola</u>								
CHLOROPHYTA								
Chlorophyta I	4	4	49	19	11	8	33	24
Flagellate (unidentified)	71	25	161	27	22	29	193	133
CHRYSOPHYTA								
<u>Bicoeca lacustris</u>								
<u>Thalassiosira fluviatilis</u>								
<u>Cyclotella meneghiniana</u>								
<u>Diatoma vulgare</u>								
<u>Fragilaria crotonensis</u>								
<u>Fragilaria leptostauron</u>								
<u>Fragilaria pinnata</u>								
<u>Fragilaria vaucheriae</u>								
<u>Synedra amphicephala</u>	6		6	6	33	86	8	4
<u>Synedra ulna</u>	1	1	2	2	171	86	18	1
<u>Cocconeis pediculus</u>								
<u>Achnanthes minutissima</u>	345	30	369	149	47	33	6	2
<u>Anomoeoneis sphaerophora</u>								
<u>Navicula arvensis</u>								
<u>Navicula cryptocephala</u>	4		69	5	54	23	36	43

¹Stations 6, 10-12 and 16 were dry at the time of sampling.

Table 3-8-74. Continued.

	Station							
	7	8	9	13	14	15	17	18
CHRYSTOPHYTA (Cont.)								
<u>Navicula pelliculosa</u>								
<u>Navicula salinarum</u>								
<u>Navicula viridula</u>								
<u>Amphora ovalis</u> var. <u>pediculus</u>								
<u>Cymbella affinis</u>								
<u>Cymbella ventricosa</u>								
<u>Gomphonema olivaceum</u>								
<u>Nitzschia acicularis</u>								
<u>Nitzschia capitellata</u>								
<u>Nitzschia denticula</u>								
<u>Nitzschia fonticola</u>								
<u>Nitzschia frustulum</u>	39	17	54	20	4	14	9	9
<u>Nitzschia holsatica</u>					38	153		7
<u>Nitzschia linearis</u>								
<u>Nitzschia palea</u>		1	45	60	23	22	11	63
CRYPTOPHYTA								
<u>Cryptomonas erosa</u>			10	2	44	23	4	22

Table 3-8-75. Summary of means of densities of the most abundant algal taxa observed in the phytoplankton at the Tract Stations during RBOSP Aquatic Baseline Studies, August - September 1975. (Data are expressed as mean number of cells/ml.)

	Station				
	<u>7</u>	<u>8</u>	<u>9</u>	<u>12</u>	<u>13</u>
CYANOPHYTA					
<u>Merismopedia glauca</u>					
<u>Cyanophyta I</u>	43				
CHLOROPHYTA					
<u>Chlorophyta I</u>			76		
<u>Flagellate (unidentified)</u>	45	11	46	38	23
CHRY SOPHYTA					
<u>Chrysophyta II</u>					
<u>Cyclotella meneghiniana</u>					
<u>Achnanthes minutissima</u>	924	211	1275	37	358
<u>Navicula arvensis</u>	4	41	22	2	6
<u>Navicula cryptocephala</u>	151	20	214	64	55
<u>Chrysidiastrium ocellatum</u>		168			172
<u>Nitzschia capitellata</u>	25	3	90	1342	10
<u>Nitzschia denticula</u>	18		127	14	
<u>Nitzschia frustulum</u>	23	4	51	14	2
<u>Nitzschia palea</u>	40	11	43	50	8

Table 3-8-75. Continued.

	Station	
	<u>14</u>	<u>17</u>
CYANOPHYTA		
<u>Merismopedia glauca</u>		432
Cyanophyta I		8775
CHLOROPHYTA		
Chlorophyta I		3121
Chlorophyta II		3472
Flagellate (unidentified)	47	9796
CHRY SOPHYTA		
<u>Cyclotella meneghiniana</u>	19	92
<u>Achnanthes minutissima</u>	53	
<u>Navicula arvensis</u>		76
<u>Navicula cryptocephala</u>	19	179
<u>Chrysidiastrium ocellatum</u>		
<u>Nitzschia capitellata</u>	5	1037
<u>Nitzschia denticula</u>	11	
<u>Nitzschia frustulum</u>	4	103
<u>Nitzschia palea</u>	5	162

Table 3-8-76. Algal taxa observed in the phytoplankton at the Tract Stations during RBOSP Aquatic Baseline Studies between October-November 1974 and August-September 1975.

CYANOPHYTA

Cyanophyta I
Cyanophyta II
Chroococcus dispersus
Chroococcus limneticus
Merismopedia glauca
Merismopedia tenuissima
Lyngbya spp.
Oscillatoria tenuis
Oscillatoria spp.
Schizothrix calcicola
Anabaena spp.
Calothrix epiphytica
Calothrix spp.

CHLOROPHYTA

Chlamydomonas globosa
Chlamydomonas snowii
Ulothrix subtilissima
Ulothrix zonata
Ulothrix spp.
Stigeoclonium spp.
Cladophora spp.
Pediastrum simplex
Pediastrum simplex var. duodenarium
Dictyosphaerium pulchellum
Ankistrodesmus convolutus
Ankistrodesmus falcatus
Schroederia setigera
Quadrigula chodatii
Scenedesmus bijuga
Scenedesmus quadricauda
Actinastrum hantzschii
Mougeotia spp.
Spirogyra spp.
Zygnema spp.
Closterium jenneri
Closterium leibleinii
Closterium moniliferum
Closterium parvulum
Closterium venus
Cosmarium radiosum
Cosmarium spp.

Table 3-8-76. Continued.

Chlorophyta I
Chlorophyta II
Flagellate unidentified

CHRY SOPHYTA

Chrysophyta I
Chrysophyta II
Bicoeca lacustris
Chrysidiastrum catenatum
Chrysidiastrum ocellatum
Melosira granulata
Melosira spp.
Microsiphona potamos
Thalassiosira fluviatilis
Thalassiosira spp.
Cyclotella meneghiniana
Cyclotella stelligera
Stephanodiscus astraea
Stephanodiscus niagarae
Stephanodiscus tenuis
Diatoma hiemale
Diatoma vulgare
Meridion circulare
Fragilaria capucina
Fragilaria construens
Fragilaria crotonensis
Fragilaria pinnata
Fragilaria vaucheriae
Fragilaria spp.
Hannaea arcus
Synedra acus
Synedra amphicephala
Synedra delicatissima
Synedra famelica
Synedra minuscula
Synedra pulchella
Synedra tenera
Synedra ulna
Cocconeis pediculus
Cocconeis placentula
Achnanthes lanceolata
Achnanthes minutissima
Gyrosigma acuminatum
Pleurosigma delicatulum
Anomeoneis sphaerophora
Navicula arvensis

Navicula cryptocephala
Navicula cuspidata
Navicula gregaria
Navicula minima
Navicula pelliculosa
Navicula pygmaea
Navicula salinarum
Navicula tripunctata
Navicula viridula
Navicula spp.
Navicula sp. 1
Navicula sp. 2
Navicula sp. 3
Navicula sp. 5
Caloneis amphisbaena
Caloneis bacillum
Caloneis ventricosa
Pinnularia abaujensis
Pinnularia borealis
Pinnularia brebissonii
Pinnularia globiceps
Pinnularia viridis
Pinnularia spp.
Amphora ovalis
Amphora ovalis var. pediculus
Amphora sp. 1
Cymbella affinis
Cymbella cistula
Cymbella microcephala
Cymbella naviculiformis
Cymbella obtusiuscula
Cymbella tumida
Cymbella turgida
Cymbella ventricosa
Gomphonema intricatum
Gomphonema olivaceum
Gomphonema parvulum
Gomphonema ventricosum
Gomphonema spp.
Amphiprora alata
Epithemia sorex
Epithemia turgida
Rhopalodia gibberula
Cylindrotheca gracilis
Hantzschia amphioxys
Nitzschia acicularis
Nitzschia apiculata

Table 3-8-76. Continued.

Nitzschia capitata
Nitzschia capitellata
Nitzschia chasei
Nitzschia denticula
Nitzschia dissipata
Nitzschia fonticola
Nitzschia frustulum
Nitzschia gracilis
Nitzschia holsatica
Nitzschia linearis
Nitzschia palea
Nitzschia sigma
Nitzschia sigmoidea
Nitzschia vermicularis
Surirella angustata
Surirella ovata
Surirella ovalis

EUGLENOPHYTA

Euglena polymorpha
Euglena proxima
Euglena spp.
Trachelomonas hispida
Trachelomonas pulchella
Trachelomonas volvocina

PYRRHOPHYTA

Peridinium spp.

CRYPTOPHYTA

Cryptomonas erosa
Rhodomonas minuta

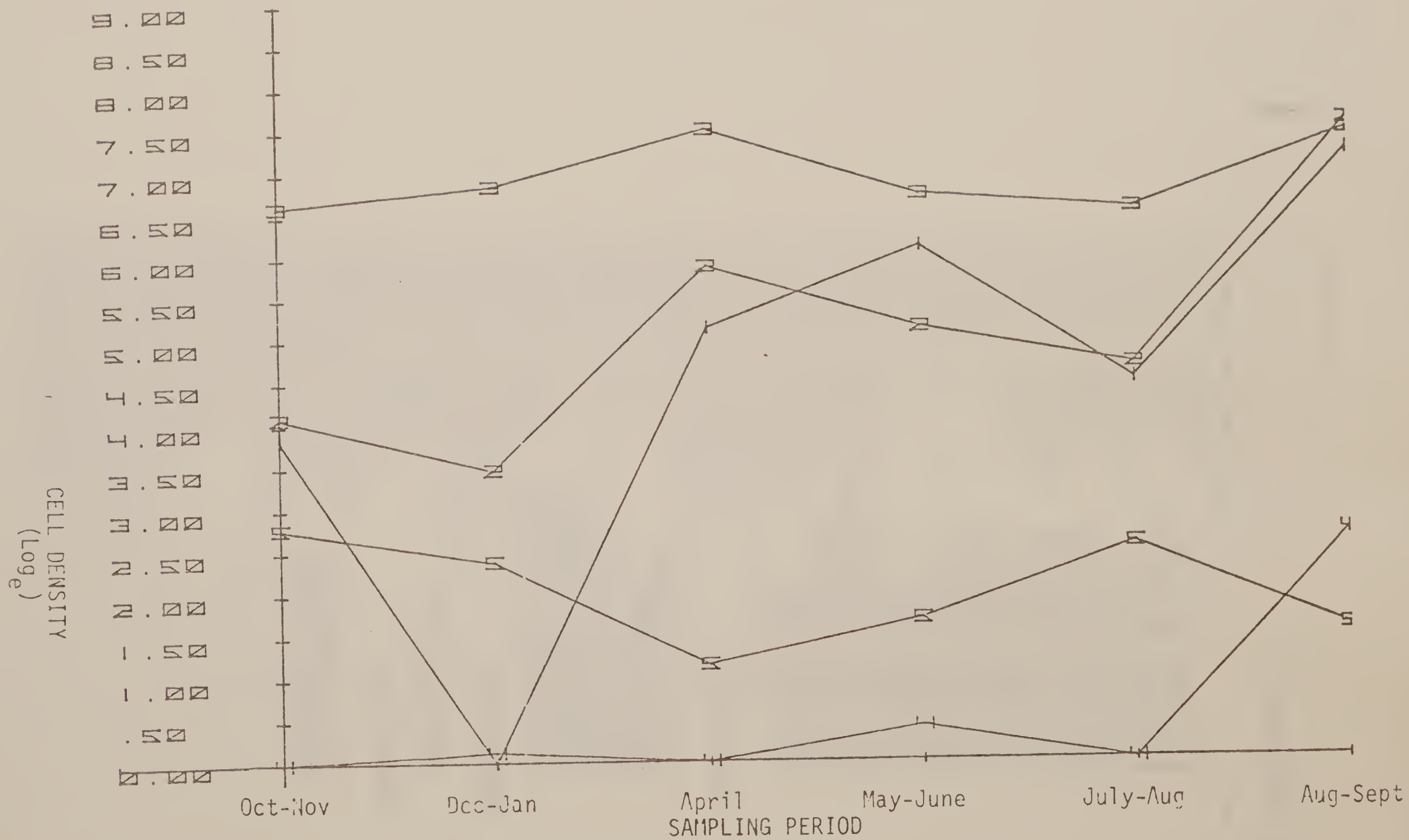


Figure 3-8-17. Log mean densities of the major algal groups in the phytoplankton at the Tract Stations during RBOSP Aquatic Baseline Studies from October - November 1974 to August - September 1975. (Cyanophyta = 1; Chlorophyta = 2; Chrysophyta = 3; Euglenophyta = 4; Pyrrhopyta = 5; and Cryptophyta = 6)

During the December 1974 - January 1975 period, Chrysophyta was again the most abundant algal group in the phytoplankton of the Tract stations. The most abundant algal species included the chrysophyte Chrysidiastrum ocellatum and the diatoms Achnanthes minutissima, Navicula salinarum, Nitzschia linearis and Bicoeca lacustris.

Phytoplankton abundance was much greater during April 1975 than during the previous sampling periods; Chrysophyta were particularly abundant. The most abundant taxa were the diatoms Achnanthes minutissima, Navicula pelliculosa, N. cryptocephala and Nitzschia frustulum; the chrysophyte Chrysidiastrum ocellatum; and unidentified green and blue-green taxa.

During May - June 1975, Chrysophyta and Cyanophyta were the most abundant algal groups at the Tract stations. The most abundant phytoplankton taxa included the diatoms Achnanthes minutissima, Navicula cryptocephala, Nitzschia denticula and N. frustulum; the blue-green Chroococcus dispersus; and unidentified blue-green and green algal taxa.

During the July - August 1975 sampling, Chrysophyta and Cyanophyta were again the most abundant algal groups. The dominant taxa included the diatoms Achnanthes minutissima, Nitzschia frustulum, N. palea, N. holsatica, Synedra ulna; an unidentified blue-green alga; and an unidentified green alga.

During the August - September 1975 sampling, phytoplankton abundance at the Tract stations was more evenly distributed among the major algal divisions than at any other time during the one year of study. During August - September 1975, the phytoplankton of the Tract stations was dominated by Achnanthes minutissima, Navicula cryptocephala and Nitzschia capitellata. In addition, at Station 17, phytoplankton abundance was very high; the dominant taxa were Nitzschia capitellata, an unidentified blue-green alga and unidentified green algal taxa.

c. Yellow Creek - Tables 3-8-77 through 3-8-82 include the mean densities of the most abundant algal taxa in the phytoplankton at the lower

Table 3-8-77. Summary of means of densities of the most abundant algal taxa observed in the phytoplankton at the Yellow Creek Stations during RBOSP Aquatic Baseline Studies, October - November 1974. (Data are expressed in number of cells/ml).

CYANOPHYTA	Station			
	19	20	21	22
<u>Chroococcus limneticus</u>				
<u>Merismopedia glauca</u>				
<u>Merismopedia tenuissima</u>		43		
<u>Oscillatoria tenuis</u>				
<u>Schizothrix calcicola</u>	1		17	6
CHLOROPHYTA				
<u>Spirogya spp.</u>		9	43	38
<u>Zygnema spp.</u>				
<u>Chlorophyta I</u>	17	38	19	19
CHRYSTOPHYTA				
<u>Chrysidiastrium ocellatum</u>				
<u>Cyclotella meneghiniana</u>				
<u>Diatoma vulgare</u>	3	194	106	306
<u>Fragilaria crotonensis</u>	4	1	28	
<u>Fragilaria pinnata</u>				
<u>Synedra amphicephala</u>			30	
<u>Synedra ulna</u>				
<u>Cocconeis pediculus</u>	1	3	8	10
<u>Cocconeis placentula</u>				
<u>Achnanthes lanceolata</u>				
<u>Achnanthes minutissima</u>				
<u>Anomoeoneis sphaerophora</u>	5	136	82	80
<u>Navicula cryptocephala</u>				
<u>Navicula salinarum</u>	3	14	8	12
<u>Navicula tripunctata</u>	2	15	21	7
<u>Navicula viridula</u>				
<u>Pinnularia brebissonii</u>				

Table 3-8-77. Continued.

CHRYSTOPHYTA (Cont.)	Station			
	19	20	21	22
<u>Cymbella affinis</u>		433	608	311
<u>Gomphonema intricatum</u>				
<u>Gomphonema olivaceum</u>				
<u>Gomphonema ventricosum</u>				
<u>Epithemia sorex</u>				
<u>Nitzschia frustulum</u>	4	22	5	10
<u>Nitzschia linearis</u>				
<u>Nitzschia palea</u>	2	1	16	10
<u>Surirella ovata</u>				
<u>Surirella ovalis</u>				
CRYPTOPHYTA				
<u>Rhodomonas minuta</u>	9	4		11

Table 3-8-78. Summary of means of densities of the most abundant algal taxa observed in the phytoplankton at the Yellow Creek Stations during RBOSP Aquatic Baseline Studies, December 1974 - January 1975. (Data are expressed in number of cells/ml).

	Station			
	<u>19</u>	<u>20</u>	<u>21</u>	<u>22</u>
CYANOPHYTA				
<u>Merismopedia tenuissima</u>				
<u>Gomphosphaeria lacustris</u>				
CHLOROPHYTA				
<u>Oedogonium spp.</u>				
<u>Micractinium pusillum</u>				
<u>Chlorophyta I</u>	18	16	26	18
CHRYSTOPHYTA				
<u>Chrysidiastrium catenatum</u>				
<u>Chrysidiastrium ocellatum</u>				
<u>Cyclotella meneghiniana</u>	2	527	444	520
<u>Diatoma vulgare</u>	16			
<u>Meridion circulare</u>				
<u>Fragilaria crotonensis</u>				
<u>Fragilaria vaucheriae</u>	2	12	23	11
<u>Synedra amphicephala</u>	17	7	14	6
<u>Synedra pulchella</u>		47	26	28
<u>Synedra ulna</u>	1	3	7	4
<u>Cocconeis pediculus</u>				
<u>Achnanthes lanceolata</u>				
<u>Achnanthes minutissima</u>	8	59	50	69

Table 3-8-78. Continued.

	Station			
	<u>19</u>	<u>20</u>	<u>21</u>	<u>22</u>
CHRYSTOPHYTA (Cont.)				
<u>Navicula cryptocephala</u>	2	10	19	9
<u>Navicula salinarum</u>	10	64	50	57
<u>Navicula tripunctata</u>			3	7
<u>Cymbella affinis</u>	1	127	85	81
<u>Gomphonema intricatum</u>	1	16	7	6
<u>Gomphonema olivaceum</u>	2	7	4	4
<u>Gomphonema ventricosum</u>				
<u>Epithemia sorex</u>				
<u>Nitzschia dissipata</u>				
<u>Nitzschia frustulum</u>	18	8	14	11
<u>Nitzschia linearis</u>				
<u>Nitzschia palea</u>				
<u>Surirella ovata</u>				
CRYPTOPHYTA				
<u>Rhodomonas minuta</u>				

Table 3-8-79. Summary of means of densities of the most abundant algal taxa observed in the phytoplankton at the Yellow Creek Stations during RBOSP Aquatic Baseline Studies, April 1975. (Data are expressed in number of cells/ml).

	Station			
	<u>19</u>	<u>20</u>	<u>21</u>	<u>22</u>
CYANOPHYTA				
Cyanophyta I				
<u>Oscillatoria tenuis</u>				
CHLOROPHYTA				
<u>Ulothrix subtilissima</u>				
<u>Dictyosphaerium pulchellum</u>				
Chlorophyta I	284	33	94	208
Flagellate (unidentified)	84	135	235	284
CHRYSTOPHYTA				
<u>Chrysidiastrium ocellatum</u>				
<u>Microsiphona potamos</u>				
<u>Thalassiosira fluviatilis</u>				
<u>Cyclotella meneghiniana</u>	6	432	140	319
<u>Diatoma vulgare</u>				
<u>Fragilaria pinnata</u>				
<u>Fragilaria vaucheriae</u>		60	46	114
<u>Synedra amphicephala</u>	143	30	14	16

Table 3-8-79. Continued.

	Station			
	<u>19</u>	<u>20</u>	<u>21</u>	<u>22</u>
CHRYSOPHYTA (Cont.)				
<u>Cocconeis pediculus</u>				
<u>Achnanthes lanceolata</u>				
<u>Achnanthes minutissima</u>	22	103	21	30
<u>Navicula arvensis</u>				
<u>Navicula cryptocephala</u>	62	95	70	41
<u>Navicula pelliculosa</u>	124	90	141	459
<u>Navicula salinarum</u>		30	40	89
<u>Navicula tripunctata</u>				
<u>Navicula viridula</u>	11		89	27
<u>Cymbella affinis</u>				
<u>Gomphonema intricatum</u>				
<u>Gomphonema olivaceum</u>				
<u>Gomphonema ventricosum</u>				
<u>Amphiprora alata</u>		76	76	41
<u>Nitzschia frustulum</u>	116	38	68	108
<u>Nitzschia palea</u>				
<u>Surirella ovata</u>	70	1750	960	1882
<u>Surirella ovalis</u>	3	62	29	60
CRYPTOPHYTA				
<u>Rhodomonas minuta</u>	143		3	103

Table 3-8-80. Summary of means of densities of the most abundant algal taxa observed in the phytoplankton at the Yellow Creek Stations during RBOSP Aquatic Baseline Studies, May - June 1975. (Data are expressed in number of cells/ml).

	Station			
	19	20	21	22
CYANOPHYTA				
Cyanophyta I				
Cyanophyta II				
<u>Chroococcus dispersus</u>	108			
CHLOROPHYTA				
<u>Carteria dissecta</u>				
<u>Ulothrix subtilissima</u>				
Chlorophyta I	107	127	21	65
Chlorophyta II				
Flagellate (unidentified)	106	124	136	53
CHRYSTOPHYTA				
<u>Bicoeca lacustris</u>	74			
<u>Thalassiosira fluviatilis</u>				
<u>Cyclotella meneghiniana</u>	30	10965	4300	9337
<u>Stephanodiscus astraes</u>				
<u>Stephanodiscus tenuis</u>				
<u>Fragilaria pinnata</u>				
<u>Synedra pulchella</u>		92	26	33
<u>Achnanthes lanceolata</u>				

Table 3-8-80. Continued.

CHRYSTOPHYTA (Cont.)	Station:			
	19	20	21	22
<u>Achnanthes minutissima</u>	8	594	94	76
<u>Navicula arvensis</u>				
<u>Navicula cryptocephala</u>	11	19	18	81
<u>Navicula gregaria</u>				
<u>Navicula pelliculosa</u>				
<u>Navicula salinarum</u>				
<u>Navicula viridula</u>		119	21	224
<u>Cymbella affinis</u>				
<u>Cymbella cistula</u>				
<u>Cymbella sinuata</u>				
<u>Cymbella ventricosa</u>	2	213	20	22
<u>Amphiprora alata</u>	2	30		33
<u>Nitzschia acicularis</u>				
<u>Nitzschia denticula</u>				
<u>Nitzschia frustulum</u>	77	24		14
<u>Nitzschia linearis</u>				
<u>Nitzschia palea</u>	49	43	23	119
<u>Surirella ovata</u>	2	49	5	49

Table 3-8-81. Summary of means of densities of the most abundant algal taxa observed in the phytoplankton at the Yellow Creek Stations during RBOSP Aquatic Baseline Studies, July - August 1975. (Data are expressed in number of cells/ml).

CYANOPHYTA	Station			
	19	20	21	22
Cyanophyta I	79		27	
<u>Chroococcus limneticus</u>				
<u>Schizothrix calcicola</u>				
CHLOROPHYTA				
Chlorophyta I	30	27	22	18
Flagellate (unidentified)				
CHRYSTOPHYTA				
<u>Bicoeca lacustris</u>				
<u>Thalassiosira fluviatilis</u>	53			
<u>Cyclotella meneghiniana</u>	10	971	614	559
<u>Diatoma vulgare</u>				
<u>Fragilaria crotonensis</u>		27	10	
<u>Fragilaria leptostauron</u>				
<u>Fragilaria pinnata</u>				
<u>Fragilaria vaucheriae</u>				
<u>Synedra amphicephala</u>				
<u>Synedra ulna</u>				
<u>Cocconeis pediculus</u>				
<u>Achnanthes minutissima</u>	11	17	6	7
<u>Anomoeoneis sphaerophora</u>				
<u>Navicula arvensis</u>				
<u>Navicula cryptocephala</u>	19	8	3	10

Table 3-8-81. Continued.

	Station:			
	<u>19</u>	<u>20</u>	<u>21</u>	<u>22</u>
CHRYSTOPHYTA (Cont.)				
<u>Navicula pelliculosa</u>				
<u>Navicula salinarum</u>				
<u>Navicula viridula</u>		137	150	15
<u>Amphora ovalis</u> var. <u>pediculus</u>				
<u>Cymbella affinis</u>				
<u>Cymbella ventricosa</u>	2	21	9	7
<u>Gomphonema olivaceum</u>				
<u>Nitzschia acicularis</u>				
<u>Nitzschia capitellata</u>	24	34	31	46
<u>Nitzschia denticula</u>				
<u>Nitzschia fonticola</u>	115	5	3	10
<u>Nitzschia frustulum</u>	19	39	66	13
<u>Nitzschia holsatica</u>	10	40	44	50
<u>Nitzschia linearis</u>				
<u>Nitzschia palea</u>	135	22	28	84
CRYPTOPHYTA				
<u>Cryptomonas erosa</u>				

Table 3-8-82. Summary of means of densities of the most abundant phytoplankton at the Yellow Creek Stations during RBOSP Aquatic Baseline Studies, August - September 1975. (Data are expressed as the mean number of cells/ml.)

	Station			
	<u>19</u>	<u>20</u>	<u>21</u>	<u>22</u>
CYANOPHYTA				
Cyanophyta I	238			
CHLOROPHYTA				
Chlorophyta I	76			
Flagellate (unidentified)	69	14	37	17
CHRY SOPHYTA				
<u>Thalassiosira fluviatilis</u>		6	7	2
<u>Cyclotella meneghiniana</u>	8	205	287	48
<u>Synedra pulchella</u>		22	30	6
<u>Achnanthes minutissima</u>	15	32	26	11
<u>Cymbella ventricosa</u>	26	18	7	14
<u>Nitzschia acicularis</u>	77			2
<u>Nitzschia capitellata</u>	122	6	23	99
<u>Nitzschia fonticola</u>	134	14	15	10
<u>Nitzschia frustulum</u>	250			
<u>Nitzschia holsatica</u>	138	26	44	97
<u>Nitzschia latens</u>			10	216
<u>Nitzschia palea</u>	84	18	29	

Yellow Creek stations for each sampling period from October - November 1974 to August - September 1975. Table 3-8-83 lists the phytoplankton taxa observed during the initial year of study; a total of 129 algal taxa were recorded from the lower Yellow Creek sampling stations. Figure 3-8-18 indicates the seasonal variation of the major algal groups in the phytoplankton of Yellow Creek during the year of study.

During October - November 1974, phytoplankton abundance was low and the dominant algal group was Chrysophyta. The dominant species were the diatoms Cymbella affinis, Cyclotella meneghiniana, and Anomoeoneis sphaerophora.

Phytoplankton abundance was also low during December 1974 - January 1975; Chrysophyta was again the dominant group. The dominant algal taxa were the diatoms Cyclotella meneghiniana, Cymbella affinis, Achnanthes minutissima and Navicula salinarum.

In the April 1975 sampling, phytoplankton abundance was markedly greater than during previous months. Abundance of both Chlorophyta and Chrysophyta increased and the two groups were dominant. The most abundant algal taxa were the diatoms Surirella ovata, Cyclotella meneghiniana and Navicula pelliculosa; and two unidentified species of Chlorophyta.

In Yellow Creek, the phytoplankton abundance recorded during May - June 1975 was the highest of the year. Chrysophyta and Chlorophyta were the dominant algal groups. Dominant taxa included the diatoms Cyclotella meneghiniana (which was particularly abundant), Achnanthes minutissima and Navicula viridula; and two unidentified Chlorophyte taxa. In May - June, phytoplankton abundance at Stations 20-22 was much greater than at Station 19.

Phytoplankton abundance was much lower in July - August 1975 than in previous samplings. Chrysophyta and Chlorophyta remained the dominant algal groups. The most abundant taxa were the diatoms Cyclotella meneghiniana and Navicula viridula. At Station 19, phytoplankton abundance was again lower than at the other Yellow Creek stations.

Table 3-8-83. Algal taxa observed in the phytoplankton at the Yellow Creek Stations during RBOSP Aquatic Baseline Studies between October-November 1974 and August-September 1975.

CYANOPHYTA

Cyanophyta I
Chroococcus dispersus
Chroococcus limneticus
Merismopedia glauca
Merismopedia tenuissima
Oscillatoria limosa
Oscillatoria tenuis
Oscillatoria spp.
Schizothrix calcicola
Anabaena spp.
Calothrix epiphytica
Calothrix spp.

CHLOROPHYTA

Chlamydomonas globosa
Chlamydomonas spp.
Ulothrix subtilissima
Ulothrix zonata
Ulothrix spp.
Cladophora spp.
Oedogonium spp.
Dictyosphaerium pulchellum
Ankistrodesmus convolutus
Ankistrodesmus falcatus
Scenedesmus bijuga
Mougeotia spp.
Spirogyra spp.
Zygnema spp.
Closterium parvulum
Chlorophyta I
Chlorophyta II
Flagellate Unidentified

CHRYSTOPHYTA

Chrysophyta I
Chrysidiastrium catenatum
Melosira varians
Melosira spp.
Thalassiosira fluviatilis
Cyclotella meneghiniana
Stephanodiscus astraea
Stephanodiscus niagarae

Table 3-8-83. Continued.

Stephanodiscus tenuis
Diatoma tenue var. elongatum
Diatoma vulgare
Meridion circulare
Fragilaria capucina
Fragilaria construens
Fragilaria crotonensis
Fragilaria leptostauron
Fragilaria pinnata
Fragilaria vaucheriae
Hannaea arcus
Synedra amphicephala
Synedra famelica
Synedra minuscula
Synedra pulchella
Synedra tenera
Synedra ulna
Asterionella formosa
Cocconeis pediculus
Cocconeis placentula
Achnanthes lanceolata
Achnanthes minutissima
Rhoicosphenia curvata
Gyrosigma acuminatum
Pleurosigma delicatulum
Anomoeoneis sphaerophora
Navicula arvensis
Navicula cryptocephala
Navicula cuspidata
Navicula lanceolata
Navicula minima
Navicula pelliculosa
Navicula pygmaea
Navicula rhyncocephala
Navicula salinarum
Navicula tripunctata
Navicula viridula
Navicula spp.
Navicula sp. 1
Navicula sp. 2
Caloneis amphisbaena
Caloneis bacillum
Pinnularia abaujensis
Pinnularia brebissonii
Amphora ovalis
Amphora ovalis var. pediculus
Cymbella affinis

Table 3-8-83. Continued.

Cymbella tumida
Cymbella ventricosa
Gomphonema intricatum
Gomphonema lanceolatum
Gomphonema olivaceum
Gomphonema parvulum
Gomphonema ventricosum
Amphiprora alata
Amphiprora ornata
Epithemia sorex
Epithemia zebra
Rhopalodia gibba
Rhopalodia gibberula
Cylindrotheca gracilis
Cylindrotheca spp.
Hantzschia amphioxys
Nitzschia acicularis
Nitzschia apiculata
Nitzschia capitata
Nitzschia capitellata
Nitzschia chasei
Nitzschia clausii
Nitzschia denticula
Nitzschia dissipata
Nitzschia fonticola
Nitzschia frustulum
Nitzschia gracilis
Nitzschia holsatica
Nitzschia hungarica
Nitzschia latens
Nitzschia linearis
Nitzschia longissima
Nitzschia microcephala
Nitzschia palea
Nitzschia sigma
Nitzschia tryblionella
Nitzschia vermicularis
Cymatopleura solea
Surirella ovata
Surirella ovalis

EUGLENOPHYTA

Euglena proxima
Euglena spp.

Table 3-8-83. Continued.

CRYPTOPHYTA

Cryptomonas erosa
Rhodomonas minuta

3-8-290

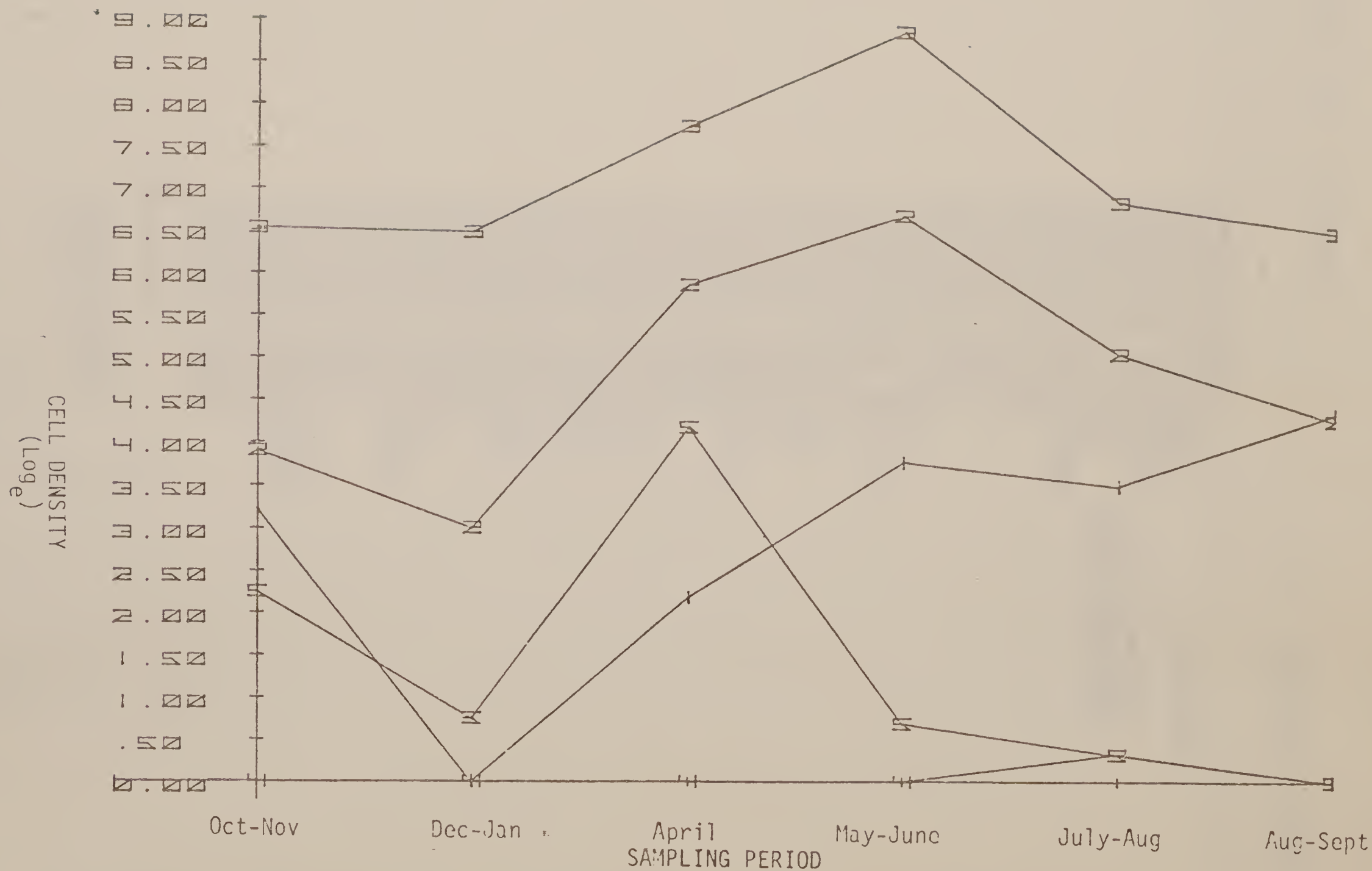


Figure 3-8-18. Log mean densities of the major algal groups in the phytoplankton at the Yellow Creek Stations during RBOSP Aquatic Baseline Studies from October - November 1974 to August - September 1975. (Cyanophyta = 1; Chlorophyta = 2; Chrysophyta = 3; Euglenophyta = 4; Pyrrhophyta = 5; and Cryptophyta = 6)

In August - September 1975, phytoplankton abundance was again low in Yellow Creek. Chrysophyta was the dominant algal group. The most abundant species were the diatoms Cyclotella meneghiniana, Nitzschia frustulum and N. latens. In August - September, differences in phytoplankton abundance among stations were not as great as during previous samplings.

d. White River - Tables 3-8-84 through 3-8-101 present the mean densities of the most abundant algal taxa in the phytoplankton at the White River stations for each sampling period from October - November 1974 to August - September 1975. Tables 3-8-102 through 3-8-104 list the phytoplankton taxa observed in the White River; Figures 3-8-19 through 3-8-21 indicate the seasonal variation of the major algal groups.

During October - November 1974, phytoplankton abundance was low and Chrysophyta was the dominant algal group. The dominant algal taxa in the phytoplankton in the White River included Navicula salinarum, Epithemia sorex and Diatoma vulgare. Phytoplankton abundance was slightly lower in the White River above its confluence with Yellow Creek than it was at or below the confluence.

In December 1974 - January 1975, phytoplankton abundance was considerably higher than in October - November 1974. Densities were highest of the one year of study in the region of the confluence with Yellow Creek. Chrysophyta were much more abundant than any other major algal group. The diatoms Diatoma vulgare, Synedra ulna, Cymbella affinis and Nitzschia frustulum were the most abundant algal species.

In April 1975, phytoplankton abundance was the maximum recorded in most White River stations during the one-year period. Maximum phytoplankton abundance was observed in the areas above and below the confluence with Yellow Creek in April (whereas maximum phytoplankton abundance in the area of the confluence occurred in December - January). Chrysophyta was the dominant algal group. The most abundant taxa were the diatoms Navicula viridula and N. cryptocephala, and unidentified green and blue-green algal

Table 3-8-84. Summary of means of densities of the most abundant algal taxa observed in the phytoplankton at the White River Stations during RBOSP Aquatic Baseline Studies, October - November 1974. (Data are expressed in number of cells/ml).

CYANOPHYTA	Above Confluence with Yellow Creek	Station				
		23	24	25	26	27
<u>Chroococcus limneticus</u>						
<u>Merismopedia glauca</u>						
<u>Merismopedia tenuissima</u>						
<u>Oscillatoria tenuis</u>						
<u>Schizothrix calcicola</u>						
CHLOROPHYTA						
<u>Spirogya spp.</u>			1			
<u>Zygnema spp.</u>						
<u>Chlorophyta I</u>	16	10	9	9	20	
CHRYSTOPHYTA						
<u>Chrysidiastrium ocellatum</u>						
<u>Cyclotella meneghiniana</u>	35	11	12	10	9	
<u>Diatoma vulgare</u>	137	9	13	4	11	
<u>Fragilaria crotonensis</u>						
<u>Fragilaria pinnata</u>	32	4		2	3	
<u>Synedra amphicephala</u>						
<u>Synedra ulna</u>	39	2	5	2	2	
<u>Cocconeis pediculus</u>						
<u>Cocconeis placentula</u>						
<u>Achnanthes lanceolata</u>						
<u>Achnanthes minutissima</u>	12	4	27	8	7	
<u>Anomoeoneis sphaerophora</u>						
<u>Navicula cryptocephala</u>	41	12	13	9	20	
<u>Navicula salinarum</u>	78	37	51	28	39	
<u>Navicula tripunctata</u>	22	2	4		3	
<u>Navicula viridula</u>						
<u>Pinnularia brebissonii</u>						

Table 3-8-84. Continued.

CHRYSTOPHYTA (Cont.)	Station				
	23	24	25	26	27
<u>Cymbella affinis</u>	30	9	4	2	9
<u>Gomphonema intricatum</u>					
<u>Gomphonema olivaceum</u>	18	6	3	4	16
<u>Gomphonema ventricosum</u>	50	3	19	3	6
<u>Epithemia sorex</u>	50	19	30	15	33
<u>Nitzschia frustulum</u>	65	14	31	24	30
<u>Nitzschia linearis</u>					
<u>Nitzschia palea</u>	15	2	2	4	8
<u>Surirella ovata</u>					
<u>Surirella ovalis</u>					
CRYPTOPHYTA					
<u>Rhodomonas minuta</u>					

-Table 3-8-85. Summary of means of densities of the most abundant algal taxa observed in the phytoplankton at the White River Stations during RBOSP Aquatic Baseline Studies, October - November 1974. (Data are expressed in number of cells/ml .)

	At Confluence with Yellow Creek	
	Station	
	28	29
CYANOPHYTA		
<u>Chroococcus limneticus</u>		
<u>Merismopedia glauca</u>		
<u>Merismopedia tenuissima</u>		
<u>Oscillatoria tenuis</u>		
<u>Schozothrix calcicola</u>		
CHLOROPHYTA		
<u>Spirogya</u> spp.		
<u>Zygnema</u> spp.		
Chlorophyta I	18	36
CHRYSTOPHYTA		
<u>Chrysidiastrium ocellatum</u>		
<u>Cyclotella meneghiniana</u>	22	89
<u>Diatoma vulgare</u>	26	29
<u>Fragilaria crotonensis</u>		
<u>Fragilaria pinnata</u>	9	21
<u>Synedra amphicephala</u>		
<u>Synedra ulna</u>	13	8
<u>Cocconeis pediculus</u>	10	21
<u>Cocconeis placentula</u>		
<u>Achnanthes lanceolata</u>		
<u>Achnanthes minutissima</u>	32	33
<u>Anomoeoneis sphaerophora</u>		
<u>Navicula cryptocephala</u>	13	21
<u>Navicula salinarum</u>	58	95
<u>Navicula tripunctata</u>		
<u>Navicula viridula</u>		
<u>Pinnularia brebissonii</u>		

Table 3-8-85. Continued.

CHRYSTOPHYTA (Cont.)	Station	
	28	29
<u>Cymbella affinis</u>	7	37
<u>Gomphonema intricatum</u>	5	15
<u>Gomphonema olivaceum</u>	8	11
<u>Gomphonema ventricosum</u>	8	35
<u>Epithemia sorex</u>	37	69
<u>Nitzschia frustulum</u>	38	58
<u>Nitzschia linearis</u>		
<u>Nitzschia palea</u>		
<u>Surirella ovata</u>		
<u>Surirella ovalis</u>		
CRYPTOPHYTA		
<u>Rhodomonas minuta</u>		

Table 3-8-86. Summary of means of densities of the most abundant algal taxa observed in the phytoplankton at the White River Stations during RBOSP Aquatic Baseline Studies, October - November 1974. (Data are expressed in number of cells/ml).

	Station					
	30	31	32	33	34	35
CYANOPHYTA	Below Confluence with Yellow Creek					
<u>Chroococcus limneticus</u>						
<u>Merismopedia glauca</u>						
<u>Merismopedia tenuissima</u>						
<u>Oscillatoria tenuis</u>						
<u>Schizothrix calcicola</u>						
CHLOROPHYTA						
<u>Spirogya</u> spp.		1				
<u>Zygnema</u> spp.						
Chlorophyta I	26	34	12	22	10	14
CHRYSTOPHYTA						
<u>Chrysidiastrium ocellatum</u>	20	28	19	32	28	35
<u>Cyclotella meneghiniana</u>	130	108	10	17	43	92
<u>Diatoma vulgare</u>						
<u>Fragilaria crotonensis</u>						
<u>Fragilaria pinnata</u>						
<u>Synedra amphicephala</u>	19	25	7	1	31	15
<u>Synedra ulna</u>	12	23	9	17	9	11
<u>Cocconeis pediculus</u>	15	35			3	19
<u>Cocconeis placentula</u>						
<u>Achnanthes lanceolata</u>	111	27	4	19	8	9
<u>Achnanthes minutissima</u>						
<u>Anomoeoneis sphaerophora</u>	19	19	15	20	26	24
<u>Navicula cryptocephala</u>	72	62	42	73	70	53
<u>Navicula salinarum</u>						
<u>Navicula tripunctata</u>						
<u>Navicula viridula</u>						
<u>Pinnularia brebissonii</u>						

Table 3-8-86. Continued.

CHRYSTOPHYTA (Cont.)	Station					
	30	31	32	33	34	35
<u>Cymbella affinis</u>	39	55	11	13	39	15
<u>Gomphonema intricatum</u>						
<u>Gomphonema olivaceum</u>	60	67	17	16	26	23
<u>Gomphonema ventricosum</u>	11	43	5	7	18	16
<u>Epithemia sorex</u>	108	113	24	40	83	80
<u>Nitzschia frustulum</u>	15	31	16	11	44	26
<u>Nitzschia linearis</u>						
<u>Nitzschia sigma</u>	10	11	2	5	10	12
<u>Surirella ovata</u>						
<u>Surirella ovalis</u>						
CRYPTOPHYTA						
<u>Rhodomonas minuta</u>						

Table 3-8-87. Summary of means of densities of the most abundant algal taxa observed in the phytoplankton at the White River Stations during RBOSP Aquatic Baseline Studies, December 1974 - January 1975. (Data are expressed in number of cells/ml).¹

	Station			
	Above Confluence with Yellow Creek			
	<u>24</u>	<u>25</u>	<u>26</u>	<u>27</u>
CYANOPHYTA				
<u>Merismopedia tenuissima</u>				
<u>Gomphonosphaeria lacustris</u>				
CHLOROPHYTA				
<u>Oedogonium spp.</u>				
<u>Micractinium pusillum</u>				
<u>Chlorophyta I</u>	50	29	36	25
CHRYSTOPHYTA				
<u>Chrysidiastrium catenatum</u>				
<u>Chrysidiastrium ocellatum</u>				
<u>Cyclotella meneghiniana</u>	14	19	16	27
<u>Diatoma vulgare</u>	657	478	573	598
<u>Meridion circulare</u>				
<u>Fragilaria crotonensis</u>				
<u>Fragilaria vaucheriae</u>				
<u>Synedra amphicephala</u>				
<u>Synedra pulchella</u>				
<u>Synedra ulna</u>	238	115	226	114
<u>Cocconeis pediculus</u>				
<u>Achnanthes lanceolata</u>				
<u>Achnanthes minutissima</u>	7	15	18	30

Table 3-8-87. (Continued)

	Station.			
	<u>24</u>	<u>25</u>	<u>26</u>	<u>27</u>
CHRYSTOPHYTA (Cont.)				
<u>Navicula cryptocephala</u>	18	32	41	53
<u>Navicula salinarum</u>	56	38	41	32
<u>Navicula tripunctata</u>	75	49	164	68
<u>Cymbella affinis</u>				
<u>Gomphonema intricatum</u>	39	11	40	37
<u>Gomphonema olivaceum</u>	54	52	52	77
<u>Gomphonema ventricosum</u>	41	30	52	72
<u>Epithemia sorex</u>	4	14	22	46
<u>Nitzschia dissipata</u>	121	53	131	19
<u>Nitzschia frustulum</u>	4	64	10	3
<u>Nitzschia linearis</u>	2	11	31	45
<u>Nitzschia palea</u>				
<u>Surirella ovata</u>				
CRYPTOPHYTA				
<u>Rhodomonas minuta</u>				

Table 3-8-88. Summary of means of densities of the most abundant algal taxa observed in the phytoplankton at the White River Stations during RBOSP Aquatic Baseline Studies, December 1974 - January 1975. (Data are expressed in number of cells/ml).

	Station	
	At Confluence with Yellow Creek	
	28	29
CYANOPHYTA		
<u>Merismopedia tenuissima</u>		
<u>Gomphosphaeria lacustris</u>		
CHLOROPHYTA		
<u>Oedogonium spp.</u>		53
<u>Micractinium pusillum</u>		
<u>Bicoeca lacustris</u>	81	16
CHRYSTOPHYTA		
<u>Chrysidiastrium catenatum</u>		
<u>Chrysidiastrium ocellatum</u>		
<u>Cyclotella meneghiniana</u>	12	41
<u>Diatoma vulgare</u>	612	653
<u>Merigion circulare</u>		
<u>Fragilaria crotonensis</u>		
<u>Fragilaria vaucheriae</u>		
<u>Synedra amphicephala</u>		
<u>Synedra pulchella</u>		
<u>Synedra ulna</u>	138	150
<u>Cocconeis pediculus</u>	35	28
<u>Achnanthes lanceolata</u>		
<u>Achnanthes minutissima</u>	8	37

Table 3-8-88. Continued.

	Station	
	28	29
CHRYSTOPHYTA (Cont.)		
<u>Navicula cryptocephala</u>	29	48
<u>Navicula salinarum</u>	74	27
<u>Navicula tripunctata</u>		
<u>Cymbella affinis</u>	63	72
<u>Gomphonema intricatum</u>		
<u>Gomphonema olivaceum</u>	23	26
<u>Gomphonema ventricosum</u>	77	77
<u>Epithemia sorex</u>	58	64
<u>Nitzschia dissipata</u>	14	49
<u>Nitzschia frustulum</u>	98	72
<u>Nitzschia linearis</u>		
<u>Nitzschia palea</u>		
<u>Surirella ovata</u>		
CRYPTOPHYTA		
<u>Rhodomonas minuta</u>		

Table 3-8-89. Summary of means of densities of the most abundant algal taxa observed in the phytoplankton at the White River Stations during RBOSP Aquatic Baseline Studies, December 1974 - January 1975. (Data are expressed in number of cells/ml).

Below Confluence with Yellow Creek	Station		
	30	31	32
CYANOPHYTA			
<u>Merismopedia tenuissima</u>			
<u>Gomphosphaeria lacustris</u>			
CHLOROPHYTA			
<u>Oedogonium spp.</u>			
<u>Micractinium pusillum</u>		54	22
<u>Bicoeca lacustris</u>	23	14	46
CHRYSTOPHYTA			
<u>Chrysidiastrium catenatum</u>			
<u>Chrysidiastrium ocellatum</u>			
<u>Cyclotella meneghiniana</u>	17	19	277
<u>Diatoma vulgare</u>	793	558	667
<u>Meridion circulare</u>			
<u>Fragilaria crotonensis</u>			
<u>Fragilaria vaucheriae</u>			
<u>Synedra amphicephala</u>			
<u>Synedra pulchella</u>			
<u>Synedra ulna</u>	161	123	54
<u>Cocconeis pediculus</u>	20	39	17
<u>Achnanthes lanceolata</u>			
<u>Achnanthes minutissima</u>	46	22	28

¹ Stations 33-35 the samples were either lost or destroyed.

Table 3-8-89. Continued.

	Stations		
	<u>30</u>	<u>31</u>	<u>32</u>
CHRYSTOPHYTA (Cont.)			
<u>Navicula cryptocephala</u>	22	35	25
<u>Navicula salinarum</u>			
<u>Navicula tripunctata</u>			
<u>Cymbella affinis</u>	85	58	59
<u>Gomphonema intricatum</u>			
<u>Gomphonema olivaceum</u>			
<u>Gomphonema ventricosum</u>	99	49	29
<u>Epithemia sorex</u>	42	45	54
<u>Nitzschia dissipata</u>	38	35	29
<u>Nitzschia frustulum</u>	31	48	49
<u>Nitzschia linearis</u>	12	42	64
<u>Nitzschia palea</u>	25	30	27
<u>Surirella ovata</u>			
CRYPTOPHYTA			
<u>Rhodomonas minuta</u>			

Table 3-8-90. Summary of means of densities of the most abundant algal taxa observed in the phytoplankton at the White River Stations during RBOSP Aquatic Baseline Studies, April 1975. (Data are expressed in number of cells/ml).

	Above Confluence with Yellow Creek				
	Station				
	<u>23</u>	<u>24</u>	<u>25</u>	<u>26</u>	<u>27</u>
CYANOPHYTA					
Cyanophyta I	87	224	297	38	65
<u>Oscillatoria tenuis</u>					
CHLOROPHYTA .					
<u>Ulothrix subtilissima</u>					
<u>Dictyosphaerium pulchellum</u>					
Chlorophyta I	192	157	168	127	49
Flagellate (unidentified)					
CHRYSTOPHYTA					
<u>Chrysidiastrium ocellatum</u>					
<u>Microsiphona potamos</u>					
<u>Thalassiosira fluviatilis</u>	367	275	270	100	251
<u>Cyclotella meneghiniana</u>					
<u>Diatoma vulgare</u>	62	24	29	38	11
<u>Fragilaria pinnata</u>	57	43	40	22	6
<u>Fragilaria vaucheriae</u>	86	24	27	27	3
<u>Synedra amphicephala</u>					

Table 3-8-90. Continued.

	Station				
	<u>23</u>	<u>24</u>	<u>25</u>	<u>26</u>	<u>27</u>
CHRYSTOPHYTA (Cont.)					
<u>Cocconeis pediculus</u>					
<u>Achnanthes lanceolata</u>					
<u>Achnanthes minutissima</u>					
<u>Navicula arvensis</u>					
<u>Navicula cryptocephala</u>	135	121	108	98	89
<u>Navicula pelliculosa</u>	62	57	46	16	95
<u>Navicula salinarum</u>					
<u>Navicula tripunctata</u>	44	67	24	19	38
<u>Navicula viridula</u>	421	459	659	659	530
<u>Cymbella affinis</u>	57	60	54	66	11
<u>Gomphonema intricatum</u>					
<u>Gomphonema olivaceum</u>	54	24	30	149	17
<u>Gomphonema ventricosum</u>	92	84	62	22	46
<u>Amphiprora alata</u>					
<u>Nitzschia frustulum</u>	57	24	70	31	38
<u>Nitzschia palea</u>					
<u>Surirella ovata</u>	35	51	65	57	17
<u>Surirella ovalis</u>					
CRYPTOPHYTA					
<u>Rhodomonas minuta</u>					

Table 3-3-91. Summary of means of densities of the most abundant algal taxa observed in the phytoplankton at the White River Stations during RBOSP Aquatic Baseline Studies, April 1975. (Data are expressed in number of cells/ml).

	At Confluence with Yellow Creek		Station	
			<u>28</u>	<u>29</u>
CYANOPHYTA				
Cyanophyta I			65	
<u>Oscillatoria tenuis</u>				
CHLOROPHYTA				
<u>Ulothrix subtilissima</u>				
<u>Dictyosphaerium pulchellum</u>			114	97
Chlorophyta I			19	27
Flagellate unidentified				
CHRYSTOPHYTA				
<u>Chrysidiastrium ocellatum</u>				
<u>Microsiphona potamos</u>				
<u>Thalassiosira fluviatilis</u>			219	171
<u>Cyclotella meneghiniana</u>			19	35
<u>Diatoma vulgare</u>				
<u>Fragilaria pinnata</u>			35	27
<u>Fragilaria vaucheriae</u>				
<u>Synedra amphicephala</u>				

Table 3-8-91. Continued

	Station	
	28	29
CHRYSTOPHYTA (Cont.)		
<u>Cocconeis pediculus</u>		
<u>Achnanthes lanceolata</u>		
<u>Achnanthes minutissima</u>		
<u>Navicula arvensis</u>		
<u>Navicula cryptocephala</u>	43	81
<u>Navicula pelliculosa</u>	41	289
<u>Navicula salinarum</u>		
<u>Navicula tripunctata</u>	33	27
<u>Navicula viridula</u>	302	243
<u>Cymbella affinis</u>	33	24
<u>Gomphonema intricatum</u>		
<u>Gomphonema olivaceum</u>	32	30
<u>Gomphonema ventricosum</u>	76	30
<u>Amphiprora alata</u>		
<u>Nitzschia frustulum</u>	19	52
<u>Nitzschia palea</u>		
<u>Surirella ovata</u>	49	62
<u>Surirella ovalis</u>		
CRYPTOPHYTA		
<u>Rhodomonas minuta</u>		

Table 3-8-92. Summary of means of densities of the most abundant algal taxa observed in the phytoplankton at the White River Stations during RBOSP Aquatic Baseline Studies, April 1975. (Data are expressed in number of cells/ml).

	Below Confluence with Yellow Creek					
	Station					
	<u>30</u>	<u>31</u>	<u>32</u>	<u>33</u>	<u>34</u>	<u>35</u>
CYANOPHYTA						
Cyanophyta I		162	162	87		
<u>Oscillatoria tenuis</u>						
CHLOROPHYTA						
<u>Ulothrix subtilissima</u>						
<u>Dictyosphaerium pulchellum</u>						
Chlorophyta I	94	130	192	300	238	97
Flagellate unidentified						
CHRY SOPHYTA						
<u>Chrysidiastrium ocellatum</u>						
<u>Microsiphona potamos</u>						
<u>Thalassiosira fluviatilis</u>	211	259	332	257	297	233
<u>Cyclotella meneghiniana</u>						
<u>Diatoma vulgare</u>						
<u>Fragilaria pinnata</u>	19	22	49	89	57	27
<u>Fragilaria vaucheriae</u>	35	48	35	84	24	11
<u>Synedra amphicephala</u>						

Table 3-8-92. Continued.

	Station					
	<u>30</u>	<u>31</u>	<u>32</u>	<u>33</u>	<u>34</u>	<u>35</u>
CHRYSTOPHYTA (Cont.)						
<u>Cocconeis pediculus</u>	16	19	3	6	8	154
<u>Achnanthes lanceolata</u>						
<u>Achnanthes minutissima</u>						
<u>Navicula arvensis</u>						
<u>Navicula cryptocephala</u>	107	154	170	127	110	99
<u>Navicula pelliculosa</u>	19	35	95	79	24	43
<u>Navicula salinarum</u>	231	33	11	30	14	22
<u>Navicula tripunctata</u>	40	68	30	41	111	19
<u>Navicula viridula</u>	21	413	333	273	281	196
<u>Cymbella affinis</u>						
<u>Gomphonema intricatum</u>						
<u>Gomphonema olivaceum</u>	25	46	46	32	49	46
<u>Gomphonema ventricosum</u>	29	1650	57	79	23	11
<u>Amphiprora alata</u>						
<u>Nitzschia frustulum</u>	27	60	63	79	49	73
<u>Nitzschia palea</u>						
<u>Surirella ovata</u>	27	70	89	57	23	27
<u>Surirella ovalis</u>						
CRYPTOPHYTA						
<u>Rhodomonas minuta</u>						

Table 3-o-93. Summary of means of densities of the most abundant algal taxa observed in the phytoplankton at the White River Stations during RBOSP Aquatic Baseline Studies, May - June 1975. (Data are expressed in number of cells/ml).

	Above Confluence with Yellow Creek				
	23	24	25	26	27
CYANOPHYTA					
Cyanophyta I	46	122	65	162	
Cyanophyta II					
<u>Chroococcus dispersus</u>					
CHLOROPHYTA					
<u>Carteria dissecta</u>					
<u>Ulothrix subtilissima</u>					
Chlorophyta I	102	127	114	181	79
Chlorophyta II		87		151	
Flagellate unidentified	37	21	43	49	42
CHRYSTOPHYTA					
<u>Bicoeca lacustris</u>					
<u>Thalassiosira fluviatilis</u>	25	76	14	25	3
<u>Cyclotella meneghiniana</u>					
<u>Stephanodiscus astraea</u>					
<u>Stephanodiscus tenuis</u>	77	49	132	57	65
<u>Fragilaria pinnata</u>	43	75	34	27	27
<u>Synedra pulchella</u>					
<u>Achnanthes lanceolata</u>					
<u>Synedra ulna</u>	12	2	7	114	6
<u>Asterionella formosa</u>	28	43	59	14	35

Table 3-8-93. Continued.

CHRYSTOPHYTA (Cont.)	Station				
	23	24	25	26	27
<u>Achnanthes minutissima</u>	<u>27</u>	<u>24</u>	<u>48</u>	<u>14</u>	<u>9</u>
<u>Navicula arvensis</u>					
<u>Navicula cryptocephala</u>	39	33	31	27	6
<u>Navicula gregaria</u>					
<u>Navicula pelliculosa</u>	10	27	28	11	46
<u>Navicula salinarum</u>					
<u>Navicula viridula</u>					
<u>Cymbella affinis</u>					
<u>Cymbella cistula</u>					
<u>Cymbella sinuata</u>					
<u>Cymbella ventricosa</u>					
<u>Amphiprora alata</u>					
<u>Nitzschia acicularis</u>					
<u>Nitzschia denticula</u>				124	
<u>Nitzschia frustulum</u>	17	25	27	38	6
<u>Nitzschia linearis</u>					
<u>Nitzschia palea</u>	25	53	14	6	14

Table 3-8-94. Summary of means of densities of the most abundant algal taxa observed in the phytoplankton at the White River Stations during RBOSP Aquatic Baseline Studies, May - June 1975. (Data are expressed in number of cells/ml).

At Confluence with Yellow Creek	Station	
	28	29
CYANOPHYTA		
Cyanophyta I	135	168
Cyanophyta II	864	137
<u>Chroococcus dispersus</u>	65	
CHLOROPHYTA		
<u>Carteria dissecta</u>		
<u>Ulothrix subtilissima</u>		
Chlorophyta I	83	57
Chlorophyta II		
Flagellate (unidentified)	36	33
CHRYSOPHYTA		
<u>Bicoeca lacustris</u>		
<u>Thalassiosira fluviatilis</u>	17	6
<u>Cyclotella meneghiniana</u>	87	38
<u>Stephanodiscus astraes</u>		
<u>Stephanodiscus tenuis</u>		12
<u>Fragilaria pinnata</u>		
<u>Synedra pulchella</u>		
<u>Achnanthes lanceolata</u>	27	3
<u>Asterionella formosa</u>	10	33

Table 3-8-94. Continued.

CHRYSOPHYTA (Cont.)	Station	
	28	29
<u>Achnanthes minutissima</u>		
<u>Navicula arvensis</u>		
<u>Navicula cryptocephala</u>	8	16
<u>Navicula gregaria</u>		
<u>Navicula pelliculosa</u>		
<u>Navicula salinarum</u>	8	16
<u>Navicula viridula</u>		
<u>Cymbella affinis</u>		
<u>Cymbella cistula</u>		
<u>Cymbella sinuata</u>		
<u>Cymbella ventricosa</u>		
<u>Amphiprora alata</u>	6	13
<u>Nitzschia acicularis</u>		
<u>Nitzschia denticula</u>	16	13
<u>Nitzschia frustulum</u>		
<u>Nitzschia linearis</u>	3	20
<u>Nitzschia palea</u>		

Table 3-8-95. Summary of means of densities of the most abundant algal taxa observed in the phytoplankton at the White River Stations during RBOSP Aquatic Baseline Studies, May - June 1975. (Data are expressed in number of cells/ml).

	Station					
	30	31	32	33	34	35
Below Confluence with Yellow Creek						
CYANOPHYTA						
Cyanophyta I		33	108	157	22	130
Cyanophyta II			22	454	130	
<u>Chroococcus dispersus</u>						
CHLOROPHYTA						
<u>Carteria dissecta</u>						
<u>Ulothrix subtilissima</u>						
Chlorophyta I	9	76	108	108	97	82
Chlorophyta II						
Flagellate unidentified						
CHRYSOPHYTA						
<u>Bicoeca lacustris</u>						
<u>Thalassiosira fluviatilis</u>		54	16	11	16	19
<u>Cyclotella meneghiniana</u>	2	4	51	44	4	9
<u>Stephanodiscus astraea</u>	2	26	15	19	6	6
<u>Stephanodiscus tenuis</u>	11	45	37	62	44	21
<u>Fragilaria pinnata</u>	5	30	24	49	23	17
<u>Synedra pulchella</u>						
<u>Achnanthes lanceolata</u>						
<u>Asterionella formosa</u>	5	56	54	19	52	16

Table 3-8-95. Continued.

CHRYSTOPHYTA (Cont.)	Station					
	30	31	32	33	34	35
<u>Achnanthes minutissima</u>						
<u>Navicula arvensis</u>						
<u>Navicula cryptocephala</u>		15	16	24	26	19
<u>Navicula gregaria</u>						
<u>Navicula pelliculosa</u>	2	8	23	19	24	20
<u>Navicula salinarum</u>						
<u>Navicula viridula</u>						
<u>Cymbella affinis</u>						
<u>Cymbella cistula</u>						
<u>Cymbella sinuata</u>						
<u>Cymbella ventricosa</u>						
<u>Amphiprora alata</u>						
<u>Nitzschia acicularis</u>	3	18	20	17	13	21
<u>Nitzschia denticula</u>						
<u>Nitzschia frustulum</u>	3	7	103	25	14	16
<u>Nitzschia linearis</u>						
<u>Nitzschia palea</u>	2	26	18	11	14	17

Table 3-8-96. Summary of means of densities of the most abundant algal taxa observed in the phytoplankton at the White River Stations during RBOSP Aquatic Baseline Studies, July - August 1975. (Data are expressed in number of cells/ml).

CYANOPHYTA	Above Confluence with Yellow Creek		Station		
	23	24	25	26	27
Cyanophyta I		11		43	22
<u>Chroococcus limneticus</u>					
<u>Schizothrix calcicola</u>	26	8	6	7	38
CHLOROPHYTA					
Chlorophyta I	21	7	6	25	17
Flagellate unidentified	48	44	26	20	75
CHRYSTOPHYTA					
<u>Bicoeca lacustris</u>					
<u>Thalassiosira fluviatilis</u>					
<u>Cyclotella meneghiniana</u>					
<u>Diatoma vulgare</u>					
<u>Fragilaria crotonensis</u>					
<u>Fragilaria leptostauron</u>					
<u>Fragilaria pinnata</u>	4	6	14	23	12
<u>Fragilaria vaucheriae</u>	10	2	7	3	54
<u>Synedra amphicephala</u>					
<u>Synedra ulna</u>	26	41	61	90	66
<u>Cocconeis pediculus</u>					
<u>Achnanthes minutissima</u>					
<u>Anomoeoneis sphaerophora</u>					
<u>Navicula arvensis</u>					
<u>Navicula cryptocephala</u>	15	13	25	39	25

Table 3-8-96. Continued.

	Stations				
	23	24	25	26	27
CHRYSOPHYTA (Cont.)					
<u>Navicula pelliculosa</u>	9	13	19	18	12
<u>Navicula salinarum</u>					
<u>Navicula viridula</u>	29	13	22	22	37
<u>Amphora ovalis</u> var. <u>pediculus</u>					
<u>Cymbella affinis</u>					
<u>Cymbella ventricosa</u>					
<u>Gomphonema olivaceum</u>	16	3	28	32	21
<u>Nitzschia acicularis</u>	11	13	26	35	11
<u>Nitzschia capitellata</u>	4	18	8	15	11
<u>Nitzschia denticula</u>					
<u>Nitzschia fonticola</u>					
<u>Nitzschia frustulum</u>					
<u>Nitzschia holsatica</u>	112	85	137	251	100
<u>Nitzschia linearis</u>					
<u>Nitzschia palea</u>	8	18	25	26	57
CRYPTOPHYTA					
<u>Cryptomonas erosa</u>					

Table 3-8-97. Summary of means of densities of the most abundant algal taxa observed in the phytoplankton at the White River Stations during RBOSP Aquatic Baseline Studies, July - August 1975. (Data are expressed in number of cells/ml .)

At Confluence with Yellow Creek		
	Station	
	28	29
CYANOPHYTA		
Cyanophyta I		
<u>Chroococcus limneticus</u>		
<u>Schizothrix calcicola</u>	20	35
CHLOROPHYTA		
Chlorophyta I		27
Flagellate unidentified	40	41
CHRYSTOPHYTA		
<u>Bicoeca lacustris</u>		43
<u>Thalassiosira fluviatilis</u>		
<u>Cyclotella meneghiniana</u>		
<u>Diatoma vulgare</u>	12	18
<u>Fragilaria crotonensis</u>		
<u>Fragilaria leptostauron</u>		
<u>Fragilaria pinnata</u>		
<u>Fragilaria vaucheriae</u>		
<u>Synedra amphicephala</u>		
<u>Synedra ulna</u>	21	73
<u>Cocconeis pediculus</u>		
<u>Achnanthes minutissima</u>		
<u>Anomoeoneis sphaerophora</u>		
<u>Navicula arvensis</u>		
<u>Navicula cryptocephala</u>	19	11

Table 3-8-97. Continued.

	Station	
	28	29
CHRYSOPHYTA (Cont.)		
<u>Navicula pelliculosa</u>		
<u>Navicula salinarum</u>		
<u>Navicula viridula</u>	23	44
<u>Amphora ovalis</u> var. <u>pediculus</u>	14	10
<u>Cymbella affinis</u>	9	25
<u>Cymbella ventricosa</u>	7	20
<u>Gomphonema olivaceum</u>	17	18
<u>Nitzschia acicularis</u>		
<u>Nitzschia capitellata</u>	4	19
<u>Nitzschia denticula</u>		
<u>Nitzschia fonticola</u>		
<u>Nitzschia frustulum</u>		
<u>Nitzschia holsatica</u>	81	130
<u>Nitzschia linearis</u>		
<u>Nitzschia palea</u>	18	8
CRYPTOPHYTA		
<u>Cryptomonas erosa</u>		

Table 3-8-98. Summary of means of densities of the most abundant algal taxa observed in the phytoplankton at the White River Stations during RBOSP Aquatic Baseline Studies, July - August 1975. (Data are expressed in number of cells/ml).

	Below Confluence with Yellow Creek					
	Station					
CYANOPHYTA	30	31	32	33	34	35
Cyanophyta I	33	81	19	27	11	30
<u>Chroococcus limneticus</u>						
<u>Schizothrix calcicola</u>	30	13			30	25
CHLOROPHYTA						
Chlorophyta I		38	31	12	6	15
Flagellate (unidentified)	115	124	51	46	73	42
CHRYSTOPHYTA						
<u>Bicoeca lacustris</u>						
<u>Thalassiosira fluviatilis</u>						
<u>Cyclotella meneghiniana</u>						
<u>Diatoma vulgare</u>	13	14	17	10	13	11
<u>Fragilaria crotonensis</u>						
<u>Fragilaria leptostauron</u>	4	160				3
<u>Fragilaria pinnata</u>						
<u>Fragilaria vaucheriae</u>						
<u>Synedra amphicephala</u>						
<u>Synedra ulna</u>	55	89	57	45	84	53
<u>Cocconeis pediculus</u>						
<u>Achnanthes minutissima</u>						
<u>Anomoeoneis sphaerophora</u>						
<u>Navicula arvensis</u>						
<u>Navicula cryptocephala</u>	19	36	21	8	19	17

Table 3-8-98. Continued.

	Station					
	30	31	32	33	34	35
CHRYSTOPHYTA (Cont.)						
<u>Navicula pelliculosa</u>						
<u>Navicula salinarum</u>	11	17	7	14	7	13
<u>Navicula viridula</u>	37	49	25	18	19	20
<u>Amphora ovalis</u> var. <u>pediculus</u>						
<u>Cymbella affinis</u>						
<u>Cymbella ventricosa</u>	13	15	12	18	14	14
<u>Gomphonema olivaceum</u>	13	21	18	7	9	12
<u>Nitzschia acicularis</u>						
<u>Nitzschia capitellata</u>	14	18	2	8	22	23
<u>Nitzschia denticula</u>						
<u>Nitzschia fonticola</u>						
<u>Nitzschia frustulum</u>						
<u>Nitzschia holsatica</u>	95	103	94	56	65	75
<u>Nitzschia linearis</u>						
<u>Nitzschia palea</u>	23	26	18	14	7	8
CRYPTOPHYTA						
<u>Cryptomonas erosa</u>						

Table 3-8-99. Summary of means of densities of the most abundant algal taxa observed in the phytoplankton at the White River Stations during RBOSP Aquatic Baseline Studies, August - September 1975. (Data are expressed in number of cells/ml).

Above Confluence with Yellow Creek					
	Station				
	<u>23</u>	<u>24</u>	<u>25</u>	<u>26</u>	<u>27</u>
CHLOROPHYTA					
Flagellate (unidentified)	35	21	25	41	27
CHRYSOPHYTA					
<u>Cyclotella meneghiniana</u>	23	7	7	27	27
<u>Fragilaria pinnata</u>	7	22	10	14	-
<u>Navicula cryptocephala</u>	33	26	10	34	26
<u>Navicula salinarum var. intermedia</u>	83	41	25	60	85
<u>Navicula tripunctata</u>	11	6	8	21	10
<u>Navicula sp.</u>	38	14	35	37	37
<u>Cymbella affinis</u>	19	7	14	23	11
<u>Gomphonema ventricosum</u>	7	7	14	22	14
<u>Nitzschia dissipata</u>	20	10	11	19	16
<u>Nitzschia fonticola</u>	50	-	-	-	3
<u>Nitzschia frustulum</u>	127	54	45	117	99
<u>Nitzschia holsatica</u>	22	13	15	30	14
<u>Nitzschia palea</u>	17	6	7	15	18
<u>Epithemia sorex</u>	303	212	175	468	312

Table 3-8-100. Summary of means of densities of the most abundant algal taxa observed in the phytoplankton at the White River Stations during RBOSP Aquatic Baseline Studies, August - September 1975. (Data are expressed in number of cells/ml).

At Confluence with Yellow Creek		
	Station	
	<u>28</u>	<u>29</u>
CHLOROPHYTA		
<u>Pandorina morum</u>	43	-
<u>Flagellate (unidentified)</u>	37	38
CHRYSTOPHYTA		
<u>Cyclotella meneghiniana</u>	7	16
<u>Fragilaria leptostauron</u>	16	14
<u>Fragilaria pinnata</u>	16	30
<u>Navicula cryptocephala</u>	18	29
<u>Navicula salinarum</u>	65	94
<u>Navicula viridula</u>	22	34
<u>Cymbella affinis</u>	19	13
<u>Nitzschia capitellata</u>	6	17
<u>Nitzschia frustulum</u>	120	119
<u>Nitzschia holsatica</u>	26	19
<u>Nitzschia palea</u>	22	22
<u>Epithemia sorex</u>	254	353

Table 3-8-101. Summary of means of densities of the most abundant algal taxa observed in the phytoplankton at the White River Stations during RBOSP Aquatic Baseline Studies, August - September 1975. (Data are expressed in number of cells/ml).

Below Confluence with Yellow Creek						
	Station					
	30	31	32	33	34	35
CHLOROPHYTA						
Flagellate (unidentified)	3	30	56	43	45	48
CHRYSTOPHYTA						
<u>Cyclotella meneghiniana</u>	19	15	20	19	15	13
<u>Navicula cryptocephala</u>	-	23	29	21	33	35
<u>Navicula salinarum</u> var. <u>intermedia</u>	91	57	107	95	99	87
<u>Navicula viridula</u>	-	26	15	31	19	19
<u>Cymbella affinis</u>	4	14	15	21	19	15
<u>Gomphonema olivaceum</u>	4	7	12	10	23	6
<u>Nitzschia capitellata</u>	6	15	14	26	22	16
<u>Nitzschia dissipata</u>	-	10	16	29	29	33
<u>Nitzschia frustulum</u>	47	41	80	119	115	96
<u>Nitzschia holsatica</u>	9	13	18	17	15	15
<u>Nitzschia palea</u>	2	10	25	12	7	7
<u>Gomphonema ventricosum</u>	2	14	14	14	30	17
<u>Epithemia sorex</u>	403	268	333	411	436	338

Table 3-8-102. Algal taxa observed in the phytoplankton in the White River above the confluence with Yellow Creek during RBOSP Aquatic Baseline Studies between October-November 1974 and August-September 1975.

CYANOPHYTA

Cyanophyta I
Cyanophyta II
Chroococcus dispersus
Chroococcus limneticus
Gomphosphaeria lacustris
Lyngbya spp.
Oscillatoria tenuis
Oscillatoria spp.
Schizothrix calcicola
Schizothrix spp.
Anabaena spp.
Plectonema spp.
Calothrix epiphytica
Calothrix spp.

CHLOROPHYTA

Chlamydomonas globosa
Pandorina morum
Sphaerocystis schroeteri
Ulothrix subtilissima
Ulothrix zonata
Ulothrix spp.
Stigeoclonium spp.
Cladophora fracta
Cladophora spp.
Oedogonium spp.
Pediastrum simplex
Pediastrum simplex var. duodenarium
Coelastrum microporum
Dictyosphaerium pulchellum
Oocystis borgei
Ankistrodesmus convolutus
Ankistrodesmus falcatus
Selenastrum minutum
Scenedesmus acuminatus
Scenedesmus bijuga
Crucigenia quadrata
Micractinium pusillum
Spirogyra spp.
Closterium leibleinii
Closterium macilentum
Closterium moniliferum

Table 3-8-102. Continued.

Closterium parvulum
Chlorophyta I
Chlorophyta II
Flagellate Unidentified

CHRYSTOPHYTA

Bicoeca lacustris
Chrysidiastrium ocellatum
Melosira varians
Thalassiosira fluviatilis
Cyclotella meneghiniana
Cyclotella spp.
Stephanodiscus astraea
Stephanodiscus tenuis
Stephanodiscus spp.
Diatoma anceps
Diatoma hiemale
Diatoma vulgare
Meridion circulare
Fragilaria capucina
Fragilaria construens
Fragilaria crotonensis
Fragilaria leptostauron
Fragilaria pinnata
Fragilaria vaucheriae
Fragilaria virescens
Hannaea arcus
Synedra acus
Synedra amphicephala
Synedra delicatissima
Synedra minuscula
Synedra pulchella
Synedra tenera
Synedra ulna
Asterionella formosa
Cocconeis pediculus
Cocconeis placentula
Achnanthes lanceolata
Achnanthes minutissima
Rhoicosphenia curvata
Gyrosigma acuminatum
Pleurosigma delicatulum
Navicula anglica
Navicula arvensis
Navicula capitata
Navicula cryptocephala

Table 3-8-102. Continued.

<u>Navicula</u> <u>cuspidata</u>
<u>Navicula</u> <u>minima</u>
<u>Navicula</u> <u>mutica</u>
<u>Navicula</u> <u>oblonga</u>
<u>Navicula</u> <u>pelliculosa</u>
<u>Navicula</u> <u>protracta</u>
<u>Navicula</u> <u>pupula</u>
<u>Navicula</u> <u>radiosa</u>
<u>Navicula</u> <u>salinarum</u>
<u>Navicula</u> <u>salinarum</u> var. <u>intermedia</u>
<u>Navicula</u> <u>tripunctata</u>
<u>Navicula</u> <u>vaucheriae</u>
<u>Navicula</u> <u>viridula</u>
<u>Navicula</u> <u>sp. 1</u>
<u>Navicula</u> <u>sp. 2</u>
<u>Navicula</u> <u>sp. 3</u>
<u>Navicula</u> <u>sp. 4</u>
<u>Caloneis</u> <u>amphisbaena</u>
<u>Caloneis</u> <u>bacillum</u>
<u>Caloneis</u> <u>sphaerophora</u>
<u>Pinnularia</u> <u>abaujensis</u>
<u>Pinnularia</u> <u>brebissonii</u>
<u>Amphora</u> <u>ovalis</u>
<u>Amphora</u> <u>ovalis</u> var. <u>pediculus</u>
<u>Cymbella</u> <u>affinis</u>
<u>Cymbella</u> <u>cistula</u>
<u>Cymbella</u> <u>mexicana</u>
<u>Cymbella</u> <u>prostrata</u>
<u>Cymbella</u> <u>sinuata</u>
<u>Cymbella</u> <u>tumida</u>
<u>Cymbella</u> <u>turgida</u>
<u>Cymbella</u> <u>ventricosa</u>
<u>Didymosphenia</u> <u>geminata</u>
<u>Gomphonema</u> <u>constrictum</u>
<u>Gomphonema</u> <u>intricatum</u>
<u>Gomphonema</u> <u>olivaceum</u>
<u>Gomphonema</u> <u>parvulum</u>
<u>Gomphonema</u> <u>ventricosum</u>
<u>Gomphonema</u> <u>spp.</u>
<u>Epithemia</u> <u>sorex</u>
<u>Epithemia</u> <u>turgida</u>
<u>Epithemia</u> <u>zebra</u>
<u>Rhopalodia</u> <u>gibba</u>
<u>Rhopalodia</u> <u>gibberula</u>
<u>Cylindrotheca</u> <u>acicularis</u>
<u>Cylindrotheca</u> <u>gracilis</u>
<u>Hantzschia</u> <u>amphioxys</u>

Table 3-8-102. Continued.

<u>Nitzschia</u>	<u>acicularis</u>
<u>Nitzschia</u>	<u>angustata</u>
<u>Nitzschia</u>	<u>apiculata</u>
<u>Nitzschia</u>	<u>baccata</u>
<u>Nitzschia</u>	<u>capitata</u>
<u>Nitzschia</u>	<u>capitellata</u>
<u>Nitzschia</u>	<u>chasei</u>
<u>Nitzschia</u>	<u>denticula</u>
<u>Nitzschia</u>	<u>dissipata</u>
<u>Nitzschia</u>	<u>fonticola</u>
<u>Nitzschia</u>	<u>frustulum</u>
<u>Nitzschia</u>	<u>gracilis</u>
<u>Nitzschia</u>	<u>holsatica</u>
<u>Nitzschia</u>	<u>linearis</u>
<u>Nitzschia</u>	<u>microcephala</u>
<u>Nitzschia</u>	<u>palea</u>
<u>Nitzschia</u>	<u>sigma</u>
<u>Nitzschia</u>	<u>sigmoidea</u>
<u>Nitzschia</u>	<u>tryblionella</u>
<u>Nitzschia</u>	<u>vermicularis</u>
<u>Cymatopleura</u>	<u>elliptica</u>
<u>Cymatopleura</u>	<u>solea</u>
<u>Surirella</u>	<u>angustata</u>
<u>Surirella</u>	<u>ovata</u>
<u>Surirella</u>	<u>ovalis</u>

EUGLENOPHYTA

Euglena spp.
Phacus spp.

PYRRHOPHYTA

Gymnodinium spp.
Peridinium pusillum
Ceratium hirundinella

CRYPTOPHYTA

Cryptomonas erosa
Rhodomonas minuta

Table 3-8-103. Algal taxa observed in the phytoplankton in the White River at confluence with Yellow Creek during RBOSP Aquatic Baseline Studies between October-November 1974 and August-September 1975.

CYANOPHYTA

Cyanophyta I
Cyanophyta II
Chroococcus dispersus
Lyngbya spp.
Oscillatoria tenuis
Oscillatoria spp.
Schizothrix calcicola
Anabaena spp.
Calothrix epiphytica
Calothrix spp.
Rivularia spp.

CHLOROPHYTA

Carteria dissecta
Pandorina morum
Ulothrix zonata
Ulothrix spp.
Stigeoclonium spp.
Cladophora fracta
Cladophora glomerata
Cladophora spp.
Oedogonium spp.
Ankistrodesmus falcatus
Crucigenia tetrapedia
Mougeotia spp.
Spirogyra spp.
Closterium leibleinii
Closterium parvulum
Chlorophyta 1
Flagellate Unidentified

CHRYSOPHYTA

Chrysophyta 1
Melosira varians
Thalassiosira fluviatilis
Cyclotella meneghiniana
Stephanodiscus astraia
Stephanodiscus tenuis
Stephanodiscus spp.
Diatoma tenue var. elongatum
Diatoma vulgare

Table 3-8-103. Continued.

Meridion circulare
Fragilaria capucina
Fragilaria construens
Fragilaria crotonensis
Fragilaria leptostauron
Fragilaria pinnata
Fragilaria vaucheriae
Hannaea arcus
Synedra amphicephala
Synedra delicatissima
Synedra rumpens
Synedra ulna
Asterionella formosa
Cocconeis pediculus
Cocconeis placentula
Achnanthes lanceolata
Achnanthes minutissima
Rhoicosphenia curvata
Amphipleura pellucida
Gyrosigma acuminatum
Pleurosigma delicatulum
Navicula arvensis
Navicula capitata
Navicula cryptocephala
Navicula cuspidata
Navicula minima
Navicula mutica
Navicula pelliculosa
Navicula protracta
Navicula pupula
Navicula radiosa
Navicula salinarum
Navicula salinarum var. intermedia
Navicula tripunctata
Navicula vaucheriae
Navicula viridula
Navicula spp.
Caloneis amphisbaena
Caloneis bacillum
Caloneis ventricosa
Pinnularia brebissonii
Pinnularia major
Amphora ovalis
Amphora ovalis var. pediculus
Cymbella affinis
Cymbella cistula
Cymbella mexicana

Table 3-8-103. Continued.

Cymbella sinuata
Cymbella tumida
Cymbella turgida
Cymbella ventricosa
Didymosphenia geminata
Gomphonema intricatum
Gomphonema lanceolatum
Gomphonema olivaceum
Gomphonema parvulum
Gomphonema ventricosum
Epithemia sorex
Rhopalodia gibba
Cylindrotheca acicularis
Cylindrotheca gracilis
Hantzschia amphioxys
Nitzschia acicularis
Nitzschia apiculata
Nitzschia baccata
Nitzschia capitata
Nitzschia capitellata
Nitzschia dissipata
Nitzschia fonticola
Nitzschia frustulum
Nitzschia gracilis
Nitzschia holsatica
Nitzschia hungarica
Nitzschia linearis
Nitzschia longissima
Nitzschia palea
Nitzschia sigma
Nitzschia sigmoidea
Nitzschia tryblionella
Nitzschia vermicularis
Nitzschia spp.
Cymatopleura elliptica
Cymatopleura solea
Surirella angustata
Surirella ovata
Surirella ovalis

EUGLENOPHYTA

Euglena proxima
Trachelomonas pulchella

Table 3-8-103. Continued.

CRYPTOPHYTA

Cryptomonas erosa
Rhodomonas minuta

Table 3-8-104. Algal taxa observed in the phytoplankton in the White River below the confluence with Yellow Creek during RBOSP Aquatic Baseline Studies between October-November 1974 and August-September 1975.

CYANOPHYTA

Cyanophyta I
Cyanophyta II
Chroococcus dispersus
Chroococcus limneticus
Merismopedia glauca
Merismopedia tenuissima
Lyngbya spp.
Oscillatoria tenuis
Oscillatoria spp.
Schizothrix calcicola
Anabaena spp.
Calothrix epiphytica
Calothrix spp.
Rivularia spp.

CHLOROPHYTA

Chlamydomonas globosa
Pandorina morum
Sphaerocystis schroeteri
Ulothrix zonata
Ulothrix spp.
Stigeoclonium spp.
Cladophora fracta
Cladophora spp.
Pediastrum duplex
Pediastrum simplex
Coelastrum microporum
Ankistrodesmus convolutus
Ankistrodesmus falcatus
Scenedesmus bijuga
Scenedesmus quadricauda
Crucigenia tetrapedia
Micractinium pusillum
Mougeotia spp.
Spirogyra spp.
Closterium leibleinii
Closterium moniliferum
Closterium parvulum
Closterium venus
Cosmarium turpinii
Cosmarium spp.
Chlorophyta I
Flagellate Unidentified

Table 3-8-104. Continued.

CHRYSOPHYTA

Chrysophyta I
Synura uvella
Chrysidiastrum ocellatum
Melosira italica
Melosira varians
Thalassiosira fluviatilis
Cyclotella meneghiniana
Cyclotella spp.
Stephanodiscus astraea
Stephanodiscus niagarae
Stephanodiscus tenuis
Stephanodiscus spp.
Diatoma hiemale
Diatoma vulgare
Meridion circulare
Fragilaria capucina
Fragilaria construens
Fragilaria crotonensis
Fragilaria leptostauron
Fragilaria pinnata
Fragilaria vaucheriae
Hannaea arcus
Synedra amphicephala
Synedra delicatissima
Synedra rumpens
Synedra tenera
Synedra ulna
Asterionella formosa
Cocconeis pediculus
Cocconeis placentula
Achnanthes lanceolata
Achnanthes minutissima
Rhoicosphenia curvata
Amphipleura pellucida
Gyrosigma acuminatum
Pleurosigma delicatulum
Anomoeoneis bacillum
Anomoeoneis sphaerophora
Neidium iridis
Diploneis elliptica
Diploneis ovalis
Navicula arvensis
Navicula capitata
Navicula cryptocephala

Table 3-8-104. Continued.

<u>Navicula</u>	<u>cryptocephala</u>	var. <u>veneta</u>
<u>Navicula</u>	<u>cuspidata</u>	
<u>Navicula</u>	<u>exigua</u>	
<u>Navicula</u>	<u>gregaria</u>	
<u>Navicula</u>	<u>lanceolata</u>	
<u>Navicula</u>	<u>minima</u>	
<u>Navicula</u>	<u>oblonga</u>	
<u>Navicula</u>	<u>pelliculosa</u>	
<u>Navicula</u>	<u>pupula</u>	
<u>Navicula</u>	<u>rhyncocephala</u>	
<u>Navicula</u>	<u>salinarum</u>	
<u>Navicula</u>	<u>salinarum</u>	var. <u>intermedia</u>
<u>Navicula</u>	<u>tantula</u>	
<u>Navicula</u>	<u>tripunctata</u>	
<u>Navicula</u>	<u>vaucheriae</u>	
<u>Navicula</u>	<u>viridula</u>	
<u>Navicula</u>	<u>sp. 1</u>	
<u>Navicula</u>	<u>sp. 2</u>	
<u>Navicula</u>	<u>sp. 4</u>	
<u>Navicula</u>	<u>sp. 5</u>	
<u>Caloneis</u>	<u>amphisbaena</u>	
<u>Caloneis</u>	<u>bacillum</u>	
<u>Caloneis</u>	<u>ventricosa</u>	
<u>Pinnularia</u>	<u>abaujensis</u>	
<u>Pinnularia</u>	<u>borealis</u>	
<u>Pinnularia</u>	<u>brebissonii</u>	
<u>Pinnularia</u>	<u>globiceps</u>	
<u>Pinnularia</u>	<u>major</u>	
<u>Pinnularia</u>	<u>viridis</u>	
<u>Amphora</u>	<u>ovalis</u>	
<u>Amphora</u>	<u>ovalis</u>	var. <u>pediculus</u>
<u>Cymbella</u>	<u>affinis</u>	
<u>Cymbella</u>	<u>cistula</u>	
<u>Cymbella</u>	<u>mexicana</u>	
<u>Cymbella</u>	<u>microcephala</u>	
<u>Cymbella</u>	<u>sinuata</u>	
<u>Cymbella</u>	<u>tumida</u>	
<u>Cymbella</u>	<u>ventricosa</u>	
<u>Didymosphenia</u>	<u>geminata</u>	
<u>Gomphonema</u>	<u>acuminatum</u>	
<u>Gomphonema</u>	<u>constrictum</u>	
<u>Gomphonema</u>	<u>intricatum</u>	
<u>Gomphonema</u>	<u>lacustris</u>	
<u>Gomphonema</u>	<u>lanceolatum</u>	
<u>Gomphonema</u>	<u>olivaceum</u>	
<u>Gomphonema</u>	<u>parvulum</u>	
<u>Gomphonema</u>	<u>ventricosum</u>	

Table 3-8-104. Continued.

Epithemia sorex
Epithemia turgida
Rhopalodia gibba
Rhopalodia gibberula
Cylindrotheca gracilis
Hantzschia amphioxys
Nitzschia acicularis
Nitzschia apiculata
Nitzschia baccata
Nitzschia capitellata
Nitzschia denticula
Nitzschia dissipata
Nitzschia fonticola
Nitzschia frustulum
Nitzschia gracilis
Nitzschia holsatica
Nitzschia hungarica
Nitzschia latens
Nitzschia linearis
Nitzschia palea
Nitzschia sigma
Nitzschia sigmoidea
Nitzschia vermicularis
Cymatopleura elliptica
Cymatopleura solea
Surirella angustata
Surirella ovata
Surirella ovalis

EUGLENOPHYTA

Euglena proxima
Euglena spp.
Trachelomonas hispida
Trachelomonas pulchella
Trachelomonas spp.

PYRRHOPHYTA

Gymnodinium spp.

CRYPTOPHYTA

Cryptomonas erosa
Rhodomonas minuta

3-8-337

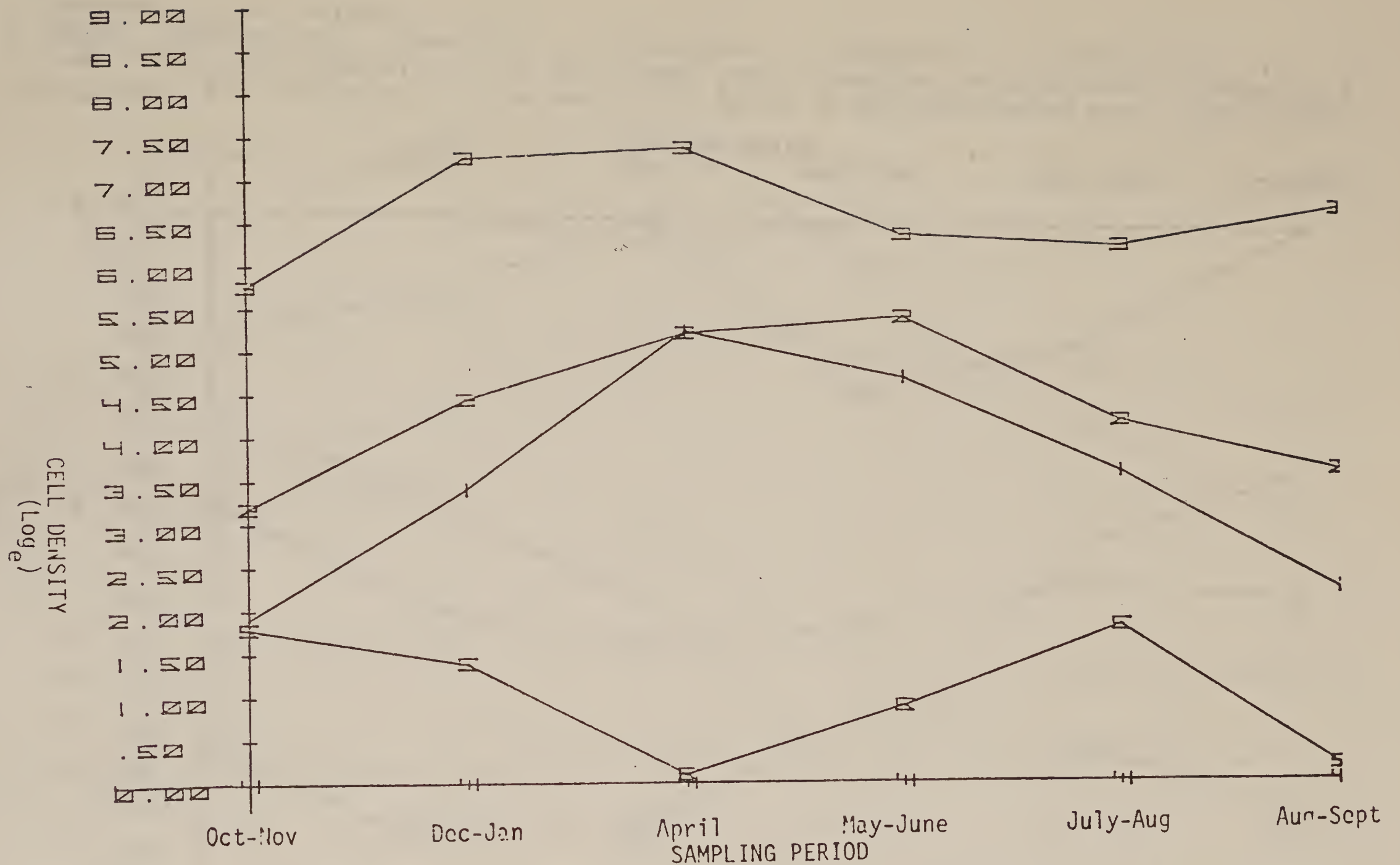


Figure 3-8-19. Log mean densities of the major algal groups in the phytoplankton of the White River Stations above confluence with Yellow Creek during RBOSP Aquatic Baseline Studies from October - November 1974 to August - September 1975. (Cyanophyta = 1; Chlorophyta = 2; Chrysophyta = 3; Euglenophyta = 4; Pyrrhopyta = 5; and Cryptophyta = 6)

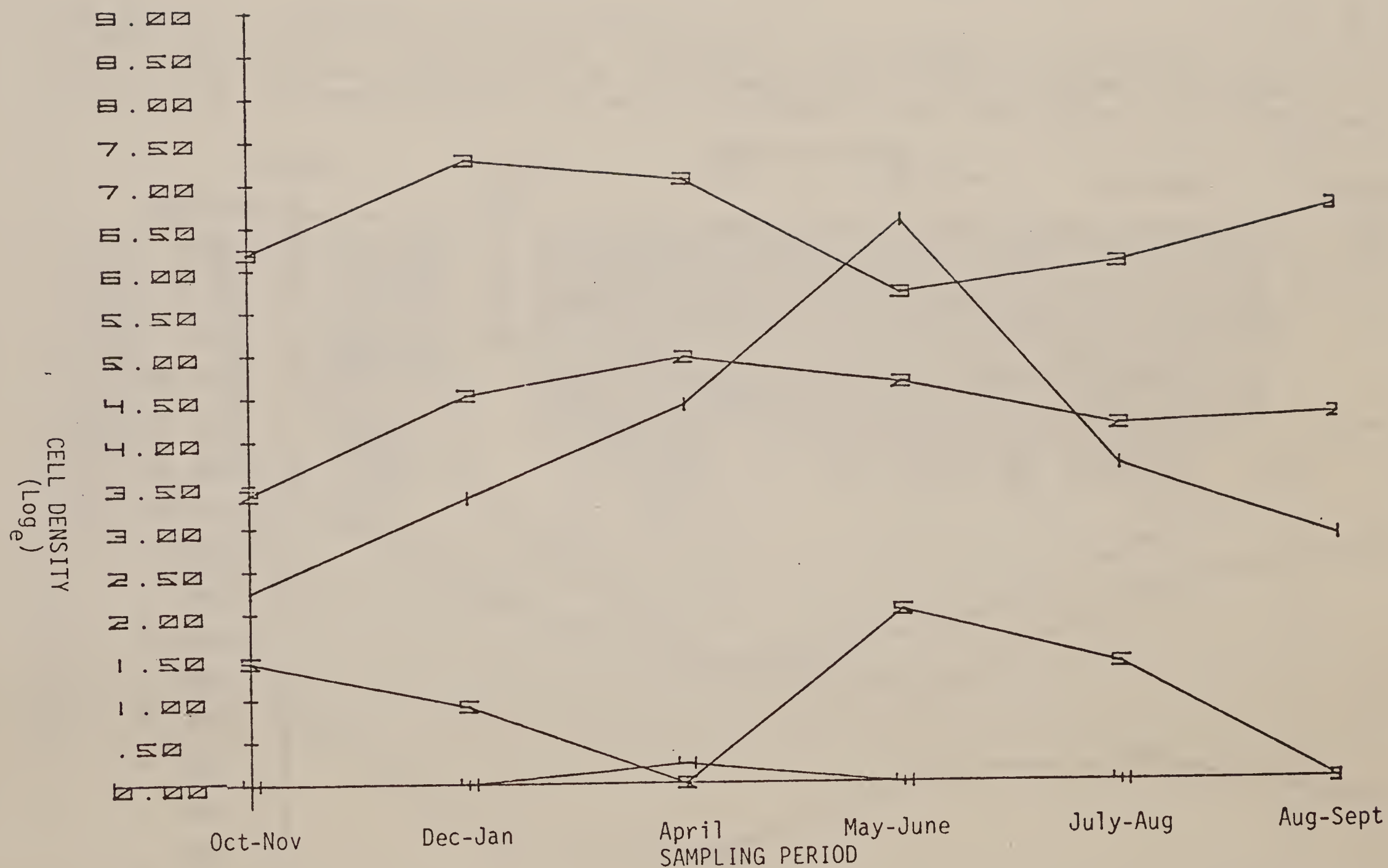


Figure 3-8-20. Log mean densities of the major algal groups in the phytoplankton at the White River Stations at confluence with Yellow Creek during RBOSP Aquatic Baseline Studies October - November 1974 to August - September 1975. (Cyanophyta = 1; Chlorophyta = 2; Chrysophyta = 3; Euglenophyta = 4; Pyrrophyta = 5; and Cryptophyta = 6)

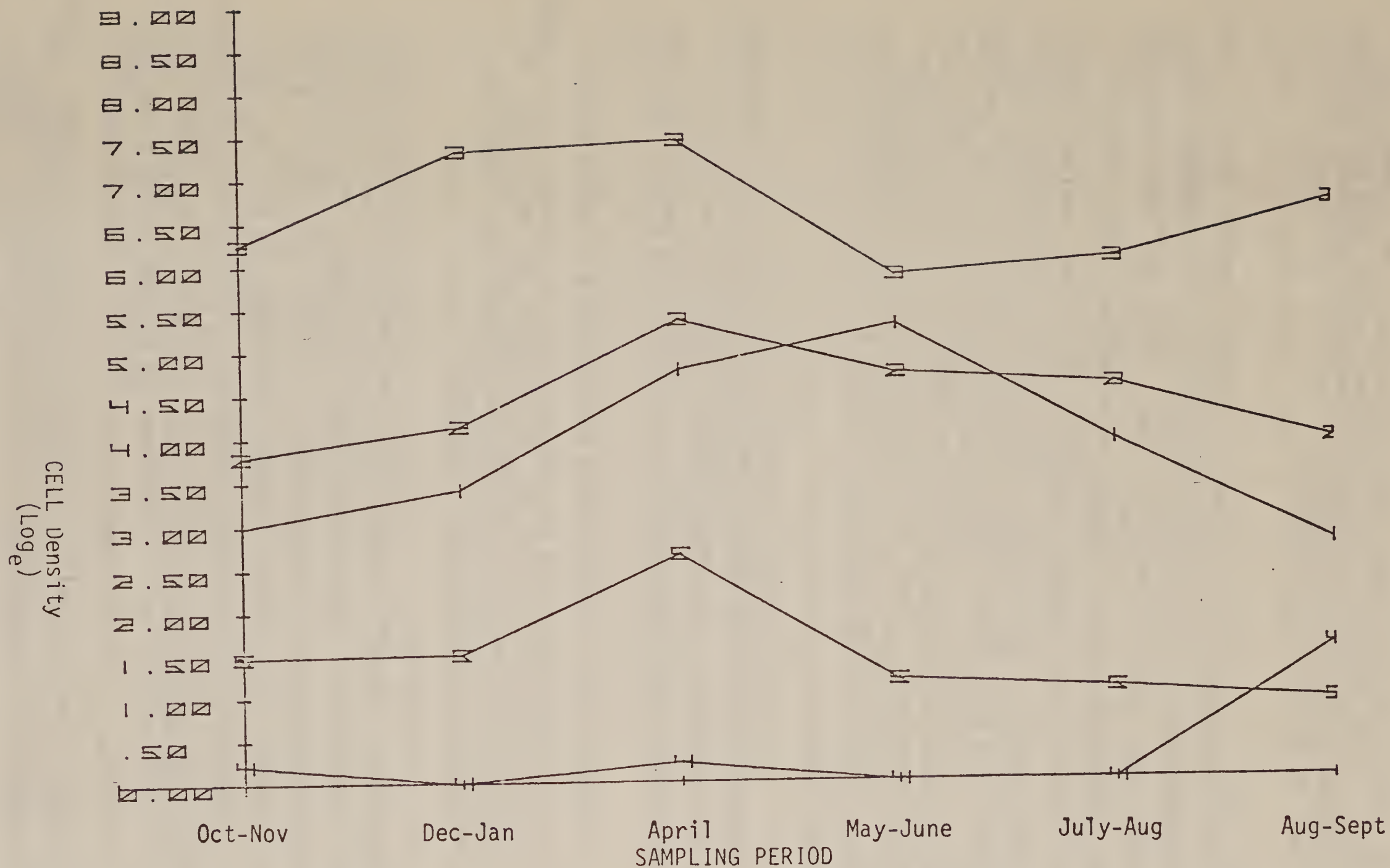


Figure 8-3-21. Log mean densities of the major algal groups in the phytoplankton at the White River Stations below confluence with Yellow Creek during RBOSP Aquatic Baseline Studies October - November 1974 to August - September 1975. (Cyanophyta = 1; Chlorophyta = 2; Chrysophyta = 3; Euglenophyta = 4; Pyrrophyta = 5; and Cryptophyta = 6)

taxa. In the area of the confluence with Yellow Creek, the diatoms Navicula pelliculosa and Thalassiosira fluviatilis were more abundant than in the other areas of the White River studied.

In May - June 1975, phytoplankton abundance decreased greatly from the April peak and the composition of the phytoplankton differed considerably among the three major study areas of the White River. Above the confluence with Yellow Creek, Chrysophyta and Chlorophyta were dominant; near the confluence with Yellow Creek, Cyanophyta and Chrysophyta were dominant; and below the confluence with Yellow Creek, Chrysophyta and Chlorophyta were again dominant. The most abundant algal taxa above and below the confluence were the diatom Stephanodiscus tenuis and unidentified taxa belonging to Chlorophyta and Cyanophyta. Near the confluence, the diatom Cyclotella meneghiniana and unidentified taxa of Chlorophyta and Cyanophyta were the most abundant algae.

In July - August 1975, Chrysophyta was the dominant group in all three study regions of the White River. The most abundant algae were the diatoms Synedra ulna and Nitzschia holsatica, and an unidentified green flagellate.

In August - September 1975, phytoplankton abundance was slightly greater than during the previous month and Chrysophyta were the dominant algal group. The most abundant species were the diatoms Epithemia sorex, Nitzschia frustulum and Navicula salinarum var. intermedia.

5. Discussion - The species composition and abundance of phytoplankton of the sampling stations in the headwater and tract regions were generally similar (except at Station 17 during August - September 1975 when a great abundance of green and blue-green algae was observed). In both of these regions, the dominant algal group was Chrysophyta, particularly the diatoms. The diatom Achnanthes minutissima appeared to be the most ubiquitous of all the species in the two regions. It was reported by Lowe (1974) to be periphytic, alkaliphilous (best development occurring at pH greater than 7), tolerant to small amounts of salt and common in springs and streams. Lowe (1974) also noted that A. minutissima is very ubiquitous and is a good

indicator of high oxygen concentrations in alkaline waters. The abundance of this taxon in the plankton can undoubtedly be attributed to its importance in the periphyton community (see Section 8.2.C).

In the headwater and tract regions, phytoplankton abundance was highest during the spring and late summer and the greatest abundance was recorded in the tract region (Figures 3-8-16 and 3-8-17). The phytoplankton of the headwater and tract regions was generally dominated by periphytic forms, although species that are considered euplanktonic (Lowe, 1974; Prescott, 1962), such as Nitzschia holsatica, Synedra ulna, Chroococcus dispersus and Chrysidiastrium ocellatum, were common. The composition of the phytoplankton generally reflected the alkaline conditions of the streams. Phytoplankton abundance was generally low in the streams and ponds of those regions, thus lending support to the contention of Prescott (1968) that there is little phytoplankton in such spring-fed streams. However, the two periods of increased phytoplankton abundance and the differing composition during the two periods suggest that the spring maximum was due to an increase in recruitment of periphyton species, whereas, the late summer increase (primarily at Station 17) of green and blue-green species was caused by the increased development of planktonic taxa.

The composition and abundance of the dominant phytoplankton taxa in lower Yellow Creek was generally different from that of the headwater and tract regions (Figure 3-8-18). In Yellow Creek, there was a major difference between the composition and abundance of phytoplankton at Station 19 (a pond area) and that of other three stations. Generally, phytoplankton abundance was considerably greater at Stations 20 - 22 than at Station 19. These differences in phytoplankton composition and abundance are likely related to differences in tolerances to such chemical factors as sulfate and hardness, both of which were highest at Station 19, while dissolved solids, sodium and chloride concentrations were generally higher at other Yellow Creek Stations.

The different physical configuration of Station 19 (a pond) also undoubtedly contributed to the differences observed. The species which was generally most ubiquitous and numerous at Stations 20 - 22 were Cyclotella

meneghiniana. This species is characterized by Lowe (1974) as being periphytic, tychoplanktonic, or euplanktonic and has an optimum pH range of 8.0 to 8.5 and is stimulated by small amounts of salt. Another species commonly found at Stations 20 - 22 was Cymbella affinis. Lowe (1974) reported that this species has an optimum pH range of 7.8 to 8.5 and tolerates small amounts of salt (less than 500 mg/l).

The composition and abundance of the dominant phytoplankton in the White River was also generally different from the phytoplankton in either Yellow Creek or in the headwater and tract areas. In the White River, the number of taxa observed in the areas above and below the confluence with Yellow Creek were similar, but fewer taxa were recorded in the area of the confluence. Algal densities in the phytoplankton of all three regions were generally similar, but the increased development of Cyanophyta (blue-green) occurred somewhat later at and below the area of the confluence. During the April and May - June 1975 sampling periods, the composition of the dominant phytoplankton taxa differed between the confluence area and the two other areas (above and below the confluence).

In the White River, the phytoplankton contained a mixture of algae derived from both periphytic and planktonic habitats. Generally, the abundance of phytoplankton was greatest during the spring and was not as great as that in Yellow Creek. Phytoplankton abundance in the White River was expected to be lower because of the paucity of slack-water areas and the swift currents.

The algal taxa in the phytoplankton of the streams considered in the RBOSP Aquatic Baseline Studies are apparently derived from both periphytic and planktonic habitats. The species composition of the phytoplankton was generally similar among the various sampling areas but there were distinct differences in the dominant taxa among the various areas. These differences undoubtedly reflect differences in physical and chemical characteristics of the sampling areas as well as differences in the potential sources of phytoplankton recruitment (i.e., benthic algae, pools, etc.).

B. Zooplankton

1. Objectives - The objectives of this aspect of the RBOSP Aquatic Baseline Studies are to collect and identify the plankton species present in the streams and to describe the plankton community at each station.

2. Methods - Between October - November 1974 and April 1975, a portable pump was used to collect zooplankton samples of at least 85, and usually 100, liters at all stations, except Stations 23 - 35 (White River). The samples were pumped into a carboy of known volume and filtered through a conical plankton net of No 25 Nitex (64 μ aperture). Samples from Stations 23 - 35 were collected with a 30-cm-diameter conical plankton net of No. 25 Nitex. This net was held at mid-depth with the mouth facing the current for a period of time which allowed at least 100 liters of water to be sampled. This volume was measured by a calibrated General Oceanics digital flowmeter centered at the mouth of the net. During and after the May - June 1975 sampling, all zooplankton samples were collected with a portable pump as described above.

The concentrated samples (100 to 200 ml) were preserved with 3-5% neutralized formalin. Time of collection and other pertinent information were recorded in the field notes. Samples of live material were periodically analyzed for identification of certain microplankters, particularly ciliates, which do not preserve well.

In the laboratory, 5 liters from an original sample of 100 liters were concentrated to 20 ml; 1 ml of the concentrate was then placed in a Sedgewick-Rafter cell and enumerated at 100X. In samples which contained large amounts of detritus, the sample was concentrated to 60 ml and 3 1-ml samples were enumerated. Only Protozoa, Rotifera and Crustacea nauplii were counted by this method. Identification of some rotifers was enhanced by examination of their trophi after the softer body parts were dissolved with sodium hypochlorite. Some taxonomic forms (mostly Crustacea) were counted from the equivalent of, at most, 100 liters of original unconcentrated sample. Ten-ml aliquots of the sample were placed in a Bogorov counting

chamber and scanned with a dissecting microscope at 12X. If the original sample was 100 liters or less, the total sample was counted. Identifications of Crustacea were confirmed by removing the organisms, dissecting when necessary, mounting on slides, and examining at high magnification with a compound microscope.

Taxonomic references used for identification of the zooplankton are presented in the literature section of this report.

3. Literature Review - Descriptions of Colorado zooplankton were begun in the late 1800's. Early studies of the Protozoa include those by Penard (1891), Beardsley (1902a), Cockerell (1911) and Edmondson (1912). The first studies of Colorado Entomostraca include those by Beardsley (1902b), Shantz (1907), Dodds (1908, 1915a, b), Marsh (1911) and Cockerell (1912). Almost no mention can be found in early literature of Colorado's rotifer fauna, other than a few notes of species occurrence in Shantz (1907) and Cockerell (1911). These early reports were largely based on studies of the eastern slope and plains area of eastern Colorado.

Since the early publications, zooplankton investigations in Colorado have extended along two lines of study: the distribution of entomostraca as related to increasing altitude and the seasonal dynamics of various lakes and/or reservoirs in the state as part of broader limnological studies.

In the first altitudinal study, Dodds (1919) categorized Colorado entomostraca as those confined to the plains, those limited to the mountains and those found at all elevations. Reed and Olive (1958) reported similar findings concerning the relationship of entomostracan distribution and altitude. They also updated the species list for Copepoda and Cladocera occurring in Colorado. Patalas (1964), in a study of the altitudinal distribution of crustacean plankton communities in northern Colorado, concluded that plankton abundance increased with decreasing altitude and that, in the plains, alkali lakes were richer in plankton abundance than non-alkali lakes.

One of the earliest ecological studies of Colorado zooplankton is that of Pennak (1944) who described the diurnal movements of zooplankton in some Colorado mountain lakes. Pennak continued such studies with subsequent descriptions of the annual cycles of Protozoa, Rotifera and Crustacea of Colorado reservoirs (1949) and mountain lakes (1955a). Other studies which include information on Colorado zooplankton are those of Pennak (1955b, 1968), Quinn (1962), Keefer (1969) and Dodson (1970, 1974). An additional study, as reported by Pennak (1966), describes the littoral vs. limnetic affinities of Colorado Crustacea and Rotifera. Studies have also extended into the seasonal faunal changes of alpine ponds (Nelder and Pennak, 1955; Schmitz, 1959).

Although numerous studies have investigated the benthic communities of Colorado streams, little information is available concerning the zooplankton of this habitat. Brinley (1950) gave an account of the plankton populations of some streams in the Rocky Mountain National Park. Zooplankton densities were extremely low, as were the number of species reported. He found only the Protozoa Loxodes, Actinosphaerium sol and Cyclidium and the rotifer Noterus (Platyias). Brinley and Katzin (1942), in a comparison of the total plankton volume in the mountain streams with that of the Ohio River Basin, found the latter to be considerably higher, a fact attributed to the fertilizing actions of the organic pollutants in the Ohio River.

Pennak (1943) conducted a comprehensive study on Boulder Creek, a stream originating in the mountain area of northern Colorado. A significant feature of the Boulder Creek zooplankton was its great variability in both numbers and composition. Rotifers encountered, in order of decreasing frequency, included Keratella quadrata (greatest abundance in November), Brachionus calyciflorus (June and July), Polyarthra trigla (December); Keratella cochlearis, Synchaeta sp. and Monostyla lunaris occurred only rarely. Crustacea collected included Cyclops bicuspidatus, Bosmina and Daphnia. Pennak also noted that the few Centropysix spp. and small dipteran larvae which occurred in the plankton had been dislodged from the stream bed by the current.

Many studies on the zooplankton of the lotic environment have been reported for areas outside of Colorado. Some of these, including those of Wiebe (1927) and Lackey (1938), have dealt mainly with the relationship between zooplankton and pollution. Other authors have largely dealt with the nature of river zooplankton, its sources, and the factors controlling its presence in the stream environment.

Kofoed (1908), in his classic study of the plankton of the Illinois River system, reported that most of the plankton in the river had originated in the lakes and backwaters associated with it, and that none of the plankters were characteristic of the river itself. Beach (1960) concluded that lakes and artificial impoundments of the Ocqueoc River system in Michigan were the major locations of development for planktonic rotifers such as Keratella cochlearis, Filinia longiseta, Synchaeta. Most of the plankton originating in the lakes decreased in quantity downstream from the lakes and eventually disappeared. The rate of this removal was related to length of stream, current, depth of water, turbulence and amount of vegetation or other objects in the channel. Chandler (1937) observed that lake plankton entering a stream decreases as it passes downstream and that this decrease is related to aquatic vegetation, to debris, and possibly to sedimentation in areas of low velocity.

Eddy (1934) suggests that the important factors influencing the development of plankton in streams are age of water (distance from source $\div$ velocity), temperature and turbidity. He further stressed that waters which carry large amounts of suspended silt develop little plankton. Williams (1966), in a survey of rotifers in the major rivers of the United States, noted that the abundance of rotifers was low in several rivers, probably as a result of their intolerance of turbulence and silt. He noted that, in most streams, heavy silt loads are associated with increased stream flow. At two of his stations, high silt conditions were associated with extremely low rotifer populations. These stations occurred in Yuma, Arizona, and near Grand Junction, Colorado, both of which are on the Colorado River.

Williams also concluded that high densities of rotifers are generally associated with water of high clarity and little turbulence.

Heavy silt loads also decrease the abundance of Crustacea. Because crustaceans are not selective feeders and because they feed on suspended materials, many crustacean zooplankters may, in turbulent water, inadvertently ingest sand, etc. which causes them to settle out of the water column (Hynes, 1970).

Pennak (1943), in his study of a mountain stream, found little evidence that the zooplankton which he collected originated in lakes near the stream. He therefore speculated that this zooplankton originated mainly from small populations inhabiting the deeper, quiet pools of the stream. He also suggested that the friction between the organisms and the stream bed and/or suspended particles caused the destruction of large numbers of the plankton.

All the papers discussed above deal with large streams, ranging in size from Boulder Creek to the Illinois and Ohio Rivers. The literature discussed below concerns the zooplankton of smaller streams and of arid climates.

Clifford (1972a, b) performed a year-long study of the drift invertebrates of two small streams in Alberta. In one study (1972a), an intermittent stream draining a marshy area exhibited significantly greater numbers of organisms in the drift during the daytime. Drifting organisms included nematodes, harpacticoids, simuliid larvae, chironomid larvae, chydorids and rotifers. The second study (1972b), that of a brown-water stream also fed by a marshy terrain, showed that Cladocera, Copepoda and Ostracoda made up a large part of the drift, both in terms of the number of organisms and in terms of biomass.

Gray (1952) reported on the Protozoa of Hobson's Brook. Results of this study indicated that: (a) ciliates were not present in the headwater springs but did occur in small pools near those headwaters; (b) the greatest number and variety of ciliates occurred in the current core; (c) the

greatest variety of species of ciliates and of total numbers were associated with green or blue-green algal communities; (d) ciliates of the stream and of the adjacent fields were the same, with recruitment from the fields and banks occurring after rains and during dry periods as a result of clods falling into the stream; and (e) a noted decrease in ciliate numbers in the summer was correlated with an enormous increase in the number of microphagous larvae (mainly Diptera).

Gray (1953) also studied the rotifer populations of Hobson's Brook. Two bdelloid rotifers, Rotifer vulgaris and Philodina, occurred in both the stream and in the adjacent fields. Gray stated that it is well known that certain bdelloids can resist desiccation. He suggested that the food supply of rotifers was the most dynamic factor in their ecology; in Hobson's Brook this food supply consisted largely of diatoms.

Hynes (1958) studied the effect of drought on the fauna of a small mountain stream in Wales. Following ten weeks of drought, a return of water resulted in an almost immediate appearance of ostracods, Cyclops, Canthocampus (a harpacticoid), and Chydorus sphaericus. He suggested that some of these organisms may have persisted in the moist gravel beneath the stream bed.

Methods of surviving drought have been described for many zooplankters. Both the young and adults of some harpacticoids can withstand brief periods of drought in moist soil without encysting (Borutskii, 1964). Harpacticoids, however, are also known to be able to encyst in the adult stage during unfavorable conditions (Cole, 1953; Smyly, 1957) but are not necessarily able to withstand desiccation. Cole (1968) stated that the sexual eggs of many forms, such as Cladocera, Ostracoda, Anostraca, and Calanoida, are able to survive long arid periods, thus enabling such forms to persist as inhabitants of temporary water bodies in arid areas. He suggested that cyclopoid copepods are not represented by many species in the temporary waters of arid regions, although he noted that Cyclops vernalis and Eucyclops agilis appear in some Arizona temporary ponds. E. vernalis and E. agilis were seen in the present study.

Rotifers are common occupants of temporary waters, surviving drought as resting eggs or, in the case of bdelloids, in the desiccated state. As these organisms are often cosmopolitan as a result of overland transport as resting eggs, their presence is governed by habitat, most importantly pH (Pennak, 1953).

Additional information concerning zooplankton of arid areas of the United States can be found in Bryce (1924), Hutchinson (1937), Wittaker and Fairbanks (1958) and Cole (1968).

4. Data Summary

a. Headwaters - Total zooplankton densities at Stations 1-5 (Tables 3-8-105 through 3-8-110) ranged from a minimum of 1,095/m³ at Station 4 in July to a maximum of 65,690/m³ at Station 5 in June (Figure 3-8-22). Stations 1 and 2 could not be sampled in December-January. The high diversity of organisms occurring at Headwater stations is shown by the number of taxa, including more than 25 Protozoa, 25 Rotifera and 16 Crustacea, occurring during the year of sampling (Table 3-8-111).

Protozoan densities varied considerably throughout the year, but generally were highest in the late spring and fall. Centropyxis spp. were the dominant taxa in most samples, although sessile ciliates were also often abundant.

Throughout the Yellow Creek drainage, the rotifer fauna is usually dominated by such taxa as bdelloids, Cephalodella, Lepadella, Colurella, Monostyla and unidentified monogononts. Differences in distribution were observed among stations and during the year. The highest number of species and densities generally occurred at Station 5. Contracted bdelloid and monogonont rotifers were usually the dominant taxa observed at Stations 1-4. These taxa were also abundant at Station 5, but were usually associated with relatively high densities of the littoral rotifers. Notholca acuminata and N. squamula were also abundant at Station 5.

Rotifers were most abundant (both in numbers and species) in June when densities of 10,000, 21,500 and 61,300/m³ occurred at Stations 4, 3 and 5, respectively. The densities at Stations 3 and 4 were primarily composed of bdelloid species, possibly introduced into the stream drift by the spring runoff. The extremely high density at Station 5 was a result of high concentrations of Lepadella patella, Notholca acuminata, N. squamula and contracted monogonont rotifers (14,200, 7,600, 13,100 and 17,700/m³, respectively). Definite seasonal occurrences were exhibited by several taxa. Euchlanis dilatata and Trichotria pocillum occurred only in summer samples (June-August) and Lecane occurred only in August-September. Notholca species were predominantly winter types, occurring from October to June. Station 5 was frozen during the December-January sampling, therefore samples were taken immediately below the seepage area in a large mass of dead and rotting vegetation. The predominance of such substrate-adhering rotifers as bdelloids (42,900/m³) at this substitute station is probably due to the habitat sampled.

Crustacean densities ranged from as few as 5/m³ (Station 5 in December-January) to as many as 10,521/m³ (Station 2 in October-November). The latter density was comprised almost wholly of copepod nauplii. Two distinct faunas were noted, one at Stations 1-4, and a second at Station 5. Only three taxa were abundant at Stations 1-4: copepod nauplii, Bryocamptus hiemalis and ostracods. These taxa occurred throughout the year, with the latter two showing no seasonal trend. Cyclopoids and Cladocera dominated the zooplankton at Station 5, with highest densities observed in July (7,675/m³). All species were restricted to the spring and summer months and only Eucyclops agilis and Chydorus sphaericus occurred into November. Eucyclops speratus and Ceriodaphnia quadrangula occurred in July-August and August-September, respectively, whereas Macrocyclus albidus and Simocephalus vetulus occurred only in July and August. Alona circumfimbriata and Pleuroxus aduncus, which occurred from May-November, were most abundant in July-August and August-September samples.

Table 3-8-105. Mean densities of the major zooplankton taxa observed at the Headwater Stations during RBOSP Aquatic Baseline Studies, October - November 1974. (Data are expressed as organisms/m³ and are the means of duplicate samples.)

	Station				
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
PROTOZOA					
<u>Centropyxis</u> spp.	13500	4100	13400	2800	2400
<u>ciliates</u> (misc.)	1200		200		200
<u>Diffugia</u> spp.	500	100		100	200
<u>Epistylis</u> spp.		100			
<u>Vorticella</u> spp.	31900	600	3200	600	100
ROTIFERA					
<u>bdelloidea</u> (unidentified)	2300	7900	2300	900	200
<u>Cephalodella</u> spp.				100	100
<u>Colurella</u> <u>adriatica</u>	100		1900		300
<u>Lepadella</u> <u>patella</u>			1600	100	1000
<u>monogononts</u> (unidentified)	100	5600	1200	100	300
<u>Monostyla</u> spp.			150		1900
<u>Notholca</u> <u>acuminata</u>					3100
<u>Notholca</u> <u>squamula</u>	1200				1800
ARTHROPODA					
Cladocera					54
<u>Alona</u> sp.					12
<u>Pleuroxus</u> <u>aduncus</u>					
Copepoda					100
Nauplii	1600	10100	1100	100	6
Cyclopoid copepodites					
<u>Bryocamptus</u> <u>hiemalis</u>	865	415	6	12	
<u>Eucyclops</u> <u>agilis</u>					12
Ostracoda					
Ostracoda (unidentified)	42	6	12	114	18

Table 3-8-106. Mean densities of the major zooplankton taxa observed at the Headwater Stations during RBOSP Aquatic Baseline Studies, December 1974 - January 1975. (Data are expressed as organisms/m³ and are the means of duplicate samples.)

	Station		
	<u>3</u>	<u>4</u>	<u>5</u>
PROTOZOA			
<u>Centropyxis</u> spp.	14200	4400	1500
<u>ciliates</u> (misc.)	300		600
<u>Diffugia</u> spp.	100	100	
<u>Epistylis</u> spp.	100		
<u>Vorticella</u> spp.	100		100
ROTIFERA			
<u>bdelloidea</u> (unidentified)		300	42900
<u>Cephalodella</u> spp.			100
<u>Colurella</u> <u>adriatica</u>	500		100
<u>Lepadella</u> <u>patella</u>			600
<u>monogononts</u> (unidentified)	300		300
<u>Monostyla</u> spp.			900
<u>Notholca</u> <u>acuminata</u>			900
<u>Notholca</u> <u>squamula</u>		100	
ARTHROPODA			
Cladocera			
<u>Alona</u> sp.			
<u>Pleuroxus</u> <u>aduncus</u>			
Copepoda			
<u>Nauplii</u>	400	500	
<u>Cyclopoid</u> copepodites			
<u>Bryocamptus</u> <u>hiemalis</u>	80	70	
<u>Eucyclops</u> <u>agilis</u>			
Ostracoda			
<u>Ostracoda</u> (unidentified)		290	5

Table 3-8-107. Mean densities of the major zooplankton taxa observed at the Headwater Stations during RBOSP Aquatic Baseline Studies, April 1975. (Data are expressed as organisms/m³ and are the means of duplicate samples.)

	Station				
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
PROTOZOA					
<u>Centropyxis</u> spp.	500	4600	800	3600	200
<u>ciliates</u> (misc.)		200			
<u>Diffugia</u> spp.		200	400		100
<u>Epistylis</u> spp.		1000			600
<u>Vorticella</u> spp.		300	100		400
ROTIFERA					
<u>bdelloidea</u> (unidentified)			6900		
<u>Cephalodella</u> spp.		100			
<u>Colurella</u> <u>adriatica</u>					100
<u>Lepadella</u> <u>patella</u>					
<u>monogononts</u> (unidentified)	1500	4700		200	500
<u>Monostyla</u> spp.					100
<u>Notholca</u> <u>acuminata</u>					100
<u>Notholca</u> <u>squamula</u>				200	100
ARTHROPODA					
Cladocera					
<u>Alona</u> sp.					
<u>Pleuroxus</u> <u>aduncus</u>					
Copepoda	100			1300	100
Nauplii					
Cyclopoid copepodites					
<u>Bryocamptus</u> <u>hiemalis</u>		195	90	275	10
<u>Eucyclops</u> <u>agilis</u>					5
Ostracoda					
Ostracoda (unidentified)	15	95	5	30	15

Table 3-8-108. Mean densities of the major zooplankton taxa observed at the Headwater Stations during RBOSP Aquatic Baseline Studies, May - June 1975. (Data are expressed as organisms/m³ and are the means of duplicate samples.)

	Station				
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
PROTOZOA					
<u>Centropyxis</u> spp.	900	6000	26500	8700	500
<u>ciliates</u> (misc.)	200		700	200	700
<u>Diffugia</u> spp.	400	1000	2100		200
<u>Epistylis</u> spp.			1100		
<u>Vorticella</u> spp.	100	300	700	400	1800
ROTIFERA					
<u>bdelloidea</u> (unidentified)	500	1900	21000	9800	3300
<u>Cephalodella</u> spp.	100		100		2300
<u>Colurella</u> <u>adriatica</u>					2500
<u>Lepadella</u> <u>patella</u>		300	100		14200
<u>monogononts</u> (unidentified)					17700
<u>Monostyla</u> spp.					1300
<u>Notholca</u> <u>acuminata</u>		800	100	100	7600
<u>Notholca</u> <u>squamula</u>		700			13100
ARTHROPODA					
Cladocera					
<u>Alona</u> sp.					
<u>Pleuroxus</u> <u>aduncus</u>					
Copepoda					
Nauplii		500	3900	200	30
Cyclopoid copepodites		5		10	115
<u>Bryocamptus</u> <u>hiemalis</u>		50	190	65	
<u>Eucyclops</u> <u>agilis</u>					85
Ostracoda					
Ostracoda (unidentified)	60	55	340	55	190

Table 3-8-109. Mean densities of the major zooplankton taxa observed at the Headwater Stations during RBOSP Aquatic Baseline Studies, July - August 1975. (Data are expressed as organisms/m³ and are the means of duplicate samples.)

	Station				
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
PROTOZOA					
<u>Centropyxis</u> spp.	3500	5000	4000	500	100
<u>ciliates</u> (misc.)	100	300			100
<u>Diffugia</u> spp.	100	200	400	100	200
<u>Epistylis</u> spp.		100			
<u>Vorticella</u> spp.		400	300		100
ROTIFERA					
<u>bdelloidea</u> (unidentified)	3600	900	1400	100	300
<u>Cephalodella</u> spp.	100	200		100	200
<u>Colurella</u> <u>adriatica</u>		100			
<u>Lepadella</u> <u>patella</u>					700
<u>monogononts</u> (unidentified)	400	200	100	200	100
<u>Monostyla</u> spp.					300
<u>Notholca</u> <u>acuminata</u>					
<u>Notholca</u> <u>squamula</u>					
ARTHROPODA					
<u>Cladocera</u>					185
<u>Alona</u> sp.					
<u>Pleuroxus</u> <u>aduncus</u>					55
<u>Copepoda</u>					
<u>Nauplii</u>	100	3500	400		2600
<u>Cyclopoid</u> copepodites					
<u>Bryocamptus</u> <u>hiemalis</u>	5	270	5	15	
<u>Eucyclops</u> <u>agilis</u>					230
<u>Ostracoda</u>					
<u>Ostracoda</u> (unidentified)	4935	25	105	75	3760

Table 3-8-110. Means densities of the major zooplankton taxa observed at the Headwater Stations during RBOSP Aquatic Baseline Studies, August - September 1975. (Data are expressed as organisms/m³ and are the means of duplicate samples.)

	Station				
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
PROTOZOA					
<u>Centropyxis</u> spp.	400	700	300	2400	300
<u>ciliates</u> (misc.)	100	100	2100		
<u>Diffugia</u> spp.					
<u>Epistylis</u> spp.		100			
<u>Vorticella</u> spp.		1300	700		
ROTIFERA					
<u>bdelloidea</u> (unidentified)	400	3100	2400	100	200
<u>Cephalodella</u> spp.					
<u>Colurella</u> <u>adriatica</u>		100			
<u>Lepadella</u> <u>patella</u>	200				
<u>monogononts</u> (unidentified)	500	100	1300	300	
<u>Monostyla</u> spp.	200				100
<u>Notholca</u> <u>acuminata</u>					
<u>Notholca</u> <u>squamula</u>					
ARTHROPODA					
Cladocera					
<u>Alona</u> sp.					65
<u>Pleuroxus</u> <u>aduncus</u>					110
Copepoda					
<u>Nauplii</u>	600		100	500	300
<u>Cyclopoid</u> copepodites					65
<u>Bryocamptus</u> <u>hiemalis</u>	40	285		15	
<u>Eucyclops</u> <u>agilis</u>					50
Ostracoda					
<u>Ostracoda</u> (unidentified)	85	15	30	115	135

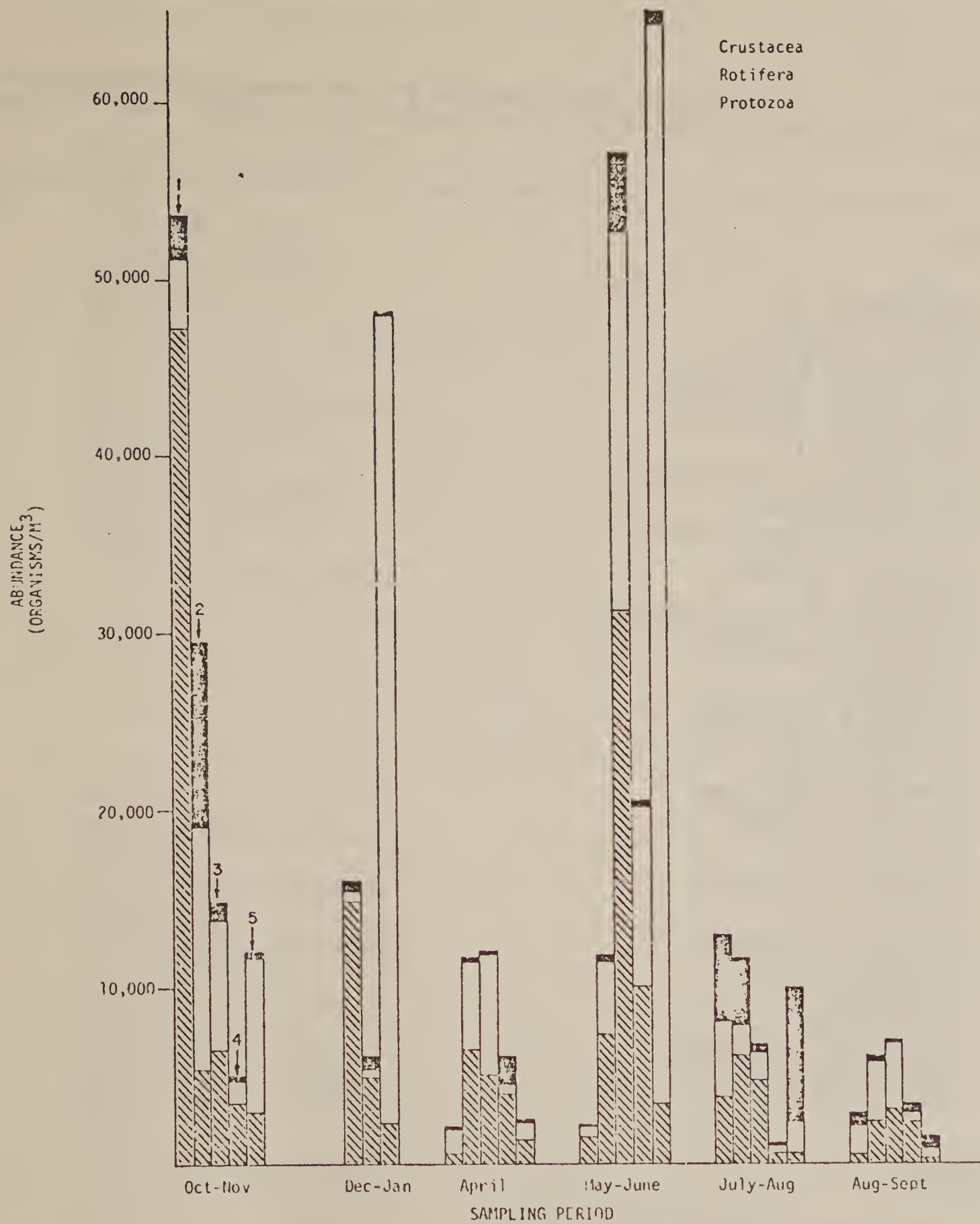


Figure 3-8-22. Zooplankton densities observed at the Headwater Stations (1-5) during RBOSP Aquatic Baseline Studies from October - November 1974 to August - September 1975. (During December 1974 - January 1975 samples were collected at Stations 3 - 5 only.)

Table 3-8-111. Zooplankton taxa observed at the Headwater Stations during RBOSP Aquatic Baseline Studies, October - November 1974 through August - September 1975.

PROTOZOA

Actinophrys sp.
Arcella vulgaris
Centropyxis aculeata
Centropyxis arcelloides
Centropyxis constricta
Centropyxis sp.
Chilodonella cucullulus
Chilodonella sp.
ciliates (unidentified)
Codonella cratera
Cothurnia sp.
Cucurbitella mespiliformis
Cyphoderia ampulla
Didinium sp.
Diffugia acuminata
Diffugia lanceolata
Diffugia lebes
Diffugia lobostoma
Diffugia oblonga
Diffugia sp.
Dinamoeba mirabilis
Epistylis sp.
Euglypha compressa
Euglypha laevis
Paramecium sp.
Strombidium sp.
Vorticella campanula
Vorticella sp.

ROTIFERA

bdelloidea (unidentified)
Cephalodella gibba
Cephalodella sp.
Colurella adriatica
Colurella dicentra
Colurella sp.
Euchlanis dilatata
Filinia sp.
Gastropus sp.

ROTIFERA (Cont.)

Kellicottia longispina
Keratella cochlearis
Lecane luna
Lepadella ovalis
Lepadella patella
Lepadella sp.
Macrotrachela sp.
Monogonont spp. (contracted)
Monostyla bulla
Monostyla closterocerca
Monostyla lunaris
Monostyla sp.
Notholca acuminata
Notholca squamula
Proales sp.
Trichotria pocillum

TARDIGRADA

ARTHROPODA

Crustacea
Amphipoda
Hyalella azteca
Cladocera
Alona circumfimbriata
Alona sp.
Ceriodaphnia quadrangula
Ceriodaphnia sp.
Chydorus sphaericus
Pleuroxus aduncus
Scapholeberis kingi
Simocephalus vetulus
Copepoda
Nauplii
Cyclopoid copepodites
Harpacticoid copepodites
Bryocamptus hiemalis
Cyclopoida sp. (unidentified)
Cyclops vernalis
Eucyclops agilis
Eucyclops speratus
Harpacticoida sp. (unidentified)
Macrocyclus albidus
Ostracoda
Ostracoda (unidentified)

b. Tract C-a - Zooplankton densities at upper Yellow Creek and on and near Tract C-a (Tables 3-8-112 through 3-8-117) ranged from as few as 705/m³ in July (Station 18) to as many as 77,100/m³ in June (Station 7) (Figure 3-8-23). The low density at Station 18 occurred during the only time during the study period that water existed at that station. More than 24 Protozoa, 21 Rotifera and 12 Crustacea taxa were identified at Stations 6-18 (Table 3-8-118). Stations 6, 15, 17 and 18 were intermittent habitats, and samples were taken at Station 6 only in June, at Stations 15 and 18 only in July, and at Station 17 in July and August. Station 7 was frozen in December-January.

Protozoan densities were highest in June, with densities between 6,000 and 20,100/m³ at Stations 7-9 and 13. Centropyxis spp. or sessile ciliates were the dominant taxa in June and in most other months. Station 14, the only station on or near the tract that was not located on a spring-brook, exhibited high densities of Protozoa in October-November. However, Vorticella (15,300/m³) composed over 90% of this protozoan density. On only a few other occasions did protozoan densities rise above 4,000/m³.

Rotifer densities varied considerably, from as few as 900/m³ at Station 8 in October-November to as many as 64,800/m³ at Station 14 in June. Rotifers were most abundant in June, with densities well over 25,000/m³ at all stations. The dominant taxa at Stations 6-9 and 13 were bdelloid rotifers, with small numbers (usually less than 1,000/m³) of Colurella, Cephalodella, Lepadella and Notholca species. The rotifer fauna at Station 14, a pond choked in the summer with the macrophyte Zannichellia palustris, was dominated by Monostyla species (19,200/m³), Notholca acuminata (18,700/m³), bdelloids (11,700/m³), and Lepadella patella (9,200/m³). Whereas densities sharply decreased at other near and on Tract stations after June (less than 2,500/m³), relatively high densities, composed largely of contracted monogonont rotifers, persisted at Station 14 (30,300 and 16,400/m³ in July-August and August-September, respectively). Over 23,000 rotifers/m³ also occurred at Station 14 in October-November and the species composition was very similar to that which occurred in June. Notholca squamula, usually rare or absent, numbered over 10,000/m³ at Station 13 in October-

Table 3-8-112. Mean densities of the major zooplankton taxa observed at the Tract Stations during RBOSP Aquatic Baseline Studies, October - November 1974. (Data are expressed as organisms/m³ and are the means of duplicate samples.)

	Station				
	<u>7</u>	<u>8</u>	<u>9</u>	<u>13</u>	<u>14</u>
PROTOZOA					
<u>Centropyxis</u> spp.	3900	200	4800	400	100
<u>ciliates</u> (misc.)				300	600
<u>Diffugia</u> spp.			500		100
<u>Epistylis</u> spp.					
<u>Vorticella</u> spp.		100	1300	200	15300
ROTIFERA					
<u>bdelloidea</u> (unidentified)			800		900
<u>Cephalodella</u> spp.	100		6100	400	2800
<u>Colurella</u> <u>adriatica</u>	100			300	600
<u>Lepadella</u> <u>patella</u>	100	100	900	200	1300
<u>monogononts</u> (unidentified)	400	100	300	200	1600
<u>Monostyla</u> spp.					8600
<u>Notholca</u> <u>acuminata</u>				200	7600
<u>Notholca</u> <u>squamula</u>	100		900	10700	1100
ARTHROPODA					
Cladocera					
<u>Alona</u> sp.					
<u>Pleuroxus</u> <u>aduncus</u>		6	6		
Copepoda					
<u>Nauplii</u>	300	300	500	800	
<u>Cyclopoid</u> copepodites	12	6	24	30	189
<u>Bryocamptus</u> <u>hiemalis</u>	6	237	101	18	
<u>Eucyclops</u> <u>agilis</u>				24	101
Ostracoda					
<u>Ostracoda</u> (unidentified)	954	106	195	384	54

Table 3-8-113. Mean densities of the major zooplankton taxa observed at the Tract Stations during RBOSP Aquatic Baseline Studies, December 1974 - January 1975. (Data are expressed as organisms/m³ and are the means of duplicate samples.)

	Station			
	<u>8</u>	<u>9</u>	<u>13</u>	<u>14</u>
PROTOZOA				
<u>Centropyxis</u> spp.	400	400	1300	300
<u>ciliates</u> (misc.)	200		300	
<u>Diffugia</u> spp.				
<u>Epistylis</u> spp.				100
<u>Vorticella</u> spp.	800		100	
ROTIFERA				
<u>bdelloidea</u> (unidentified)				
<u>Cephalodella</u> spp.	300	200	100	
<u>Colurella</u> <u>adriatica</u>	400	600		200
<u>Lepadella</u> <u>patella</u>				
<u>monogononts</u> (unidentified)	400	200	300	
<u>Monostyla</u> spp.				1900
<u>Notholca</u> <u>acuminata</u>	1300			700
<u>Notholca</u> <u>squamula</u>		1600	300	200
ARTHROPODA				
Cladocera				
<u>Alona</u> sp.				
<u>Pleuroxus</u> <u>aduncus</u>				
Copepoda				
Nauplii	4100	100	100	
Cyclopoid copepodites			15	20
<u>Bryocamptus</u> <u>hiemalis</u>	1355	10		10
<u>Eucyclops</u> <u>agilis</u>	20	5	10	10
Ostracoda				
Ostracoda (unidentified)	210	45	210	15

Table 3-8-114. Mean densities of the major zooplankton taxa observed at the Tract Stations during RBOSP Aquatic Baseline Studies, April 1975. (Data are expressed as organisms/m³ and are the means of duplicate samples.)

	Station				
	<u>7</u>	<u>8</u>	<u>9</u>	<u>13</u>	<u>14</u>
PROTOZOA					
<u>Centropyxis</u> spp.	3600		700	800	300
<u>ciliates</u> (misc.)	800	500	200		500
<u>Diffugia</u> spp.		200		200	
<u>Epistylis</u> spp.					100
<u>Vorticella</u> spp.		3700	400	500	400
ROTIFERA					
<u>bdelloidea</u> (unidentified)	2600	100		19000	1000
<u>Cephalodella</u> spp.					
<u>Colurella</u> <u>adriatica</u>		500	300	100	
<u>Lepadella</u> <u>patella</u>					
<u>monogononts</u> (unidentified)		1200	700		100
<u>Monostyla</u> spp.					100
<u>Notholca</u> <u>acuminata</u>					
<u>Notholca</u> <u>squamula</u>		300	6100		200
ARTHROPODA					
Cladocera					
<u>Alona</u> sp.					
<u>Pleuroxus</u> <u>aduncus</u>					
Copepoda					
<u>Nauplii</u>		700	200	200	
<u>Cyclopoid</u> copepodites					
<u>Bryocamptus</u> <u>hiemalis</u>		15	5	15	5
<u>Eucyclops</u> <u>agilis</u>					5
Ostracoda					
<u>Ostracoda</u> (unidentified)	125	150	20	20	35

Table 3-8-115. Mean densities of the major zooplankton taxa observed at the Tract Stations during RBOSP Aquatic Baseline Studies, May - June 1975. (Data are expressed as organisms/m³ and are the means of duplicate samples.)

	Station				
	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>13</u>
PROTOZOA					
<u>Centropyxis</u> spp.	13600	12100	18400	4300	11600
<u>ciliates</u> (misc.)		400		200	300
<u>Diffugia</u> spp.	500	100	300	400	300
<u>Epistylis</u> spp.					
<u>Vorticella</u> spp.	200		300		200
ROTIFERA					
<u>bdelloidea</u> (unidentified)	37400	53800	29500	28700	24500
<u>Cephalodella</u> spp.	200				300
<u>Colurella</u> <u>adriatica</u>		200		200	500
<u>Lepadella</u> <u>patella</u>			100	1000	700
<u>monogononts</u> (unidentified)			100		200
<u>Monostyla</u> spp.					
<u>Notholca</u> <u>acuminata</u>				100	200
<u>Notholca</u> <u>squamula</u>				1300	1500
ARTHROPODA					
Cladocera					
<u>Alona</u> sp.					
<u>Pleuroxus</u> <u>aduncus</u>					
Copepoda					
<u>Nauplii</u>		2700	300	1700	
<u>Cyclopoid</u> copepodites		15		5	
<u>Bryocamptus</u> <u>hiemalis</u>	65	120	10	35	80
<u>Eucyclops</u> <u>agilis</u>					
Ostracoda					
Ostracoda (unidentified)	40	930	25	470	30

Table 3-8-115. Continued.

	<u>Station</u>
PROTOZOA	<u>14</u>
<u>Centropyxis</u> spp.	400
<u>ciliates</u> (misc.)	700
<u>Diffugia</u> spp.	
<u>Epistylis</u> spp.	
<u>Vorticella</u> spp.	100
ROTIFERA	
<u>bdelloidea</u> (unidentified)	11700
<u>Cephalodella</u> spp.	200
<u>Colurella</u> <u>adriatica</u>	200
<u>Lepadella</u> <u>patella</u>	9200
<u>monogononts</u> (unidentified)	1400
<u>Monostyla</u> spp.	19200
<u>Notholca</u> <u>acuminata</u>	18700
<u>Notholca</u> <u>squamula</u>	1400
ARTHROPODA	
Cladocera	
<u>Alona</u> sp.	
<u>Pleuroxus</u> <u>aduncus</u>	
Copepoda	
Nauplii	
Cyclopoid copepodites	15
<u>Bryocamptus</u> <u>hiemalis</u>	5
<u>Eucyclops</u> <u>agilis</u>	40
Ostracoda	
Ostracoda (unidentified)	1105

Table 3-8-116. Mean densities of the major zooplankton observed at the Tract Stations during RBOSP Aquatic Baseline Studies, July - August 1975. (Data are expressed as organisms/m³ and are the means of duplicate samples.)

	Station				
	<u>7</u>	<u>8</u>	<u>9</u>	<u>13</u>	<u>14</u>
PROTOZOA					
<u>Centropyxis</u> spp.	2700	2100	1200	700	
<u>ciliates</u> (misc.)		100		100	300
<u>Diffugia</u> spp.		100			
<u>Epistylis</u> spp.	400				100
<u>Vorticella</u> spp.	400			100	2200
ROTIFERA					
<u>bdelloidea</u> (unidentified)	100	100	1700	400	
<u>Cephalodella</u> spp.			100		
<u>Colurella</u> <u>adriatica</u>			100		
<u>Lepadella</u> <u>patella</u>		100	300		3600
<u>monogononts</u> (unidentified)	100		100	200	17800
<u>Monostyla</u> spp.					4700
<u>Notholca</u> <u>acuminata</u>					300
<u>Notholca</u> <u>squamula</u>	100			100	
ARTHROPODA					
Cladocera					
<u>Alona</u> sp.					
<u>Pleuroxus</u> <u>aduncus</u>					
Copepoda					
<u>Nauplii</u>		1000	800	100	
<u>Cyclopoid</u> copepodites	5	5	5		
<u>Bryocamptus</u> <u>hiemalis</u>		45	25	5	
<u>Eucyclops</u> <u>agilis</u>		5	10		10
Ostracoda					
<u>Ostracoda</u> (unidentified)	225	35	210	5	35

Table 3-8-116. Continued

	Tract Stations (Continued)		Station
	<u>15</u>	<u>17</u>	<u>18</u>
PROTOZOA			
<u>Centropyxis</u> spp.	100	100	
<u>ciliates</u> (misc.)	200	400	200
<u>Diffugia</u> spp.	100		
<u>Epistylis</u> spp.	100		
<u>Vorticella</u> spp.	500	200	200
ROTIFERA			
<u>bdelloidea</u> (unidentified)	800	200	
<u>Cephalodella</u> spp.	200		
<u>Colurella adriatica</u>			
<u>Lepadella patella</u>	700	200	
<u>monogononts</u> (unidentified)	5100	600	200
<u>Monostyla</u> spp.	100		
<u>Notholca acuminata</u>	600		
<u>Notholca squamula</u>			
ARTHROPODA			
Cladocera			
<u>Alona</u> sp.			
<u>Pleuroxus aduncus</u>			
Copepoda			
<u>Nauplii</u>			
<u>Cyclopoid copepodites</u>	5		
<u>Bryocamptus hiemalis</u>			5
<u>Eucyclops agilis</u>			
Ostracoda			
<u>Ostracoda</u> (unidentified)	10	5	

Table 3-8-117. Means densities of the major zooplankton observed at the Tract Stations during RBOSP Aquatic Baseline Studies, August - September 1975. (Data are expressed as organisms/m³ and are the means of duplicate samples.)

	Station				
	<u>7</u>	<u>8</u>	<u>9</u>	<u>12</u>	<u>13</u>
PROTOZOA					
<u>Centropyxis</u> spp.	2600	500	1600	100	1200
<u>ciliates</u> (misc.)	200	100		700	100
<u>Diffflugia</u> spp.					
<u>Epistylis</u> spp.					
<u>Vorticella</u> spp.				100	
ROTIFERA					
<u>bdelloidea</u> (unidentified)	200	200	200	1600	
<u>Cephalodella</u> spp.					
<u>Colurella</u> <u>adriatica</u>				100	
<u>Lepadella</u> <u>patella</u>	100		100		100
<u>monogononts</u> (unidentified)	200	200			100
<u>Monostyla</u> spp.	100				
<u>Notholca</u> <u>acuminata</u>					
<u>Notholca</u> <u>squamula</u>					
ARTHROPODA					
Cladocera					
<u>Alona</u> sp.	5		5		
<u>Pleuroxus</u> <u>aduncus</u>	15		10		
Copepoda					
Nauplii		200		100	
Cyclopoid copepodites	10		5		5
<u>Bryocamptus</u> <u>hiemalis</u>					
<u>Eucyclops</u> <u>agilis</u>	20	5	15	5	
Ostracoda					
Ostracoda (unidentified)	885	45	1575	5	

Table 3-8-117. Continued

	Tract Stations (Cont.)		Station			
	14	17				
PROTOZOA						
<u>Centropyxis</u> spp.	600					
<u>ciliates</u> (misc.)	100	1200				
<u>Diffugia</u> spp.	100					
<u>Epistylis</u> spp.						
<u>Vorticella</u> spp.		100				
ROTIFERA						
<u>bdelloidea</u> (unidentified)	400	600				
<u>Cephalodella</u> spp.						
<u>Colurella</u> <u>adriatica</u>	200					
<u>Lepadella</u> <u>patella</u>	700					
<u>monogononts</u> (unidentified)	11900	5100				
<u>Monostyla</u> spp.	2600	100				
<u>Notholca</u> <u>acuminata</u>	100					
<u>Notholca</u> <u>squamula</u>						
ARTHROPODA						
<u>Cladocera</u>						
<u>Alona</u> sp.	5					
<u>Pleuroxus</u> <u>aduncus</u>						
<u>Copepoda</u>						
<u>Nauplii</u>	1500					
<u>Cyclopoid</u> copepodites	345					
<u>Bryocamptus</u> <u>hiemalis</u>						
<u>Eucyclops</u> <u>agilis</u>	85					
<u>Ostracoda</u>						
<u>Ostracoda</u> (unidentified)	150					

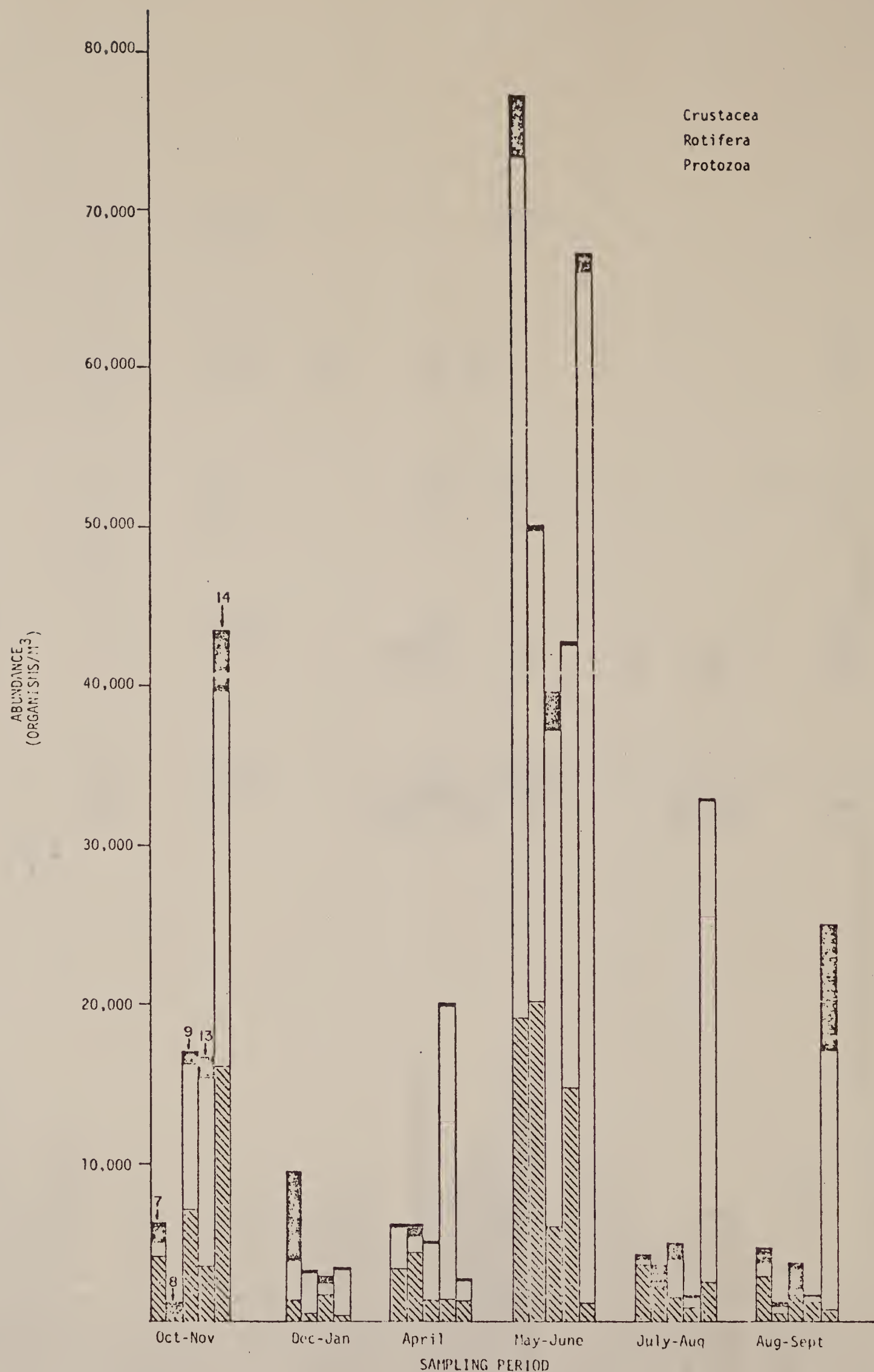


Figure 3-8-23. Zooplankton densities observed at the Tract Stations (7,8,9,13,14) which were generally flowing during RBOSP Aquatic Baseline Studies from October November 1974 to August - September 1975. (During December 1974 - January 1975 samples were taken at Station 8, 9, 13, and 14 only.)

Table 3-8-117. Continued

	Tract Stations (Cont.)		Station			
	14	17				
PROTOZOA						
<u>Centropyxis</u> spp.	600					
<u>ciliates</u> (misc.)	100	1200				
<u>Diffugia</u> spp.	100					
<u>Epistylis</u> spp.						
<u>Vorticella</u> spp.		100				
ROTIFERA						
<u>bdelloidea</u> (unidentified)	400	600				
<u>Cephalodella</u> spp.						
<u>Colurella</u> <u>adriatica</u>	200					
<u>Lepadella</u> <u>patella</u>	700					
<u>monogononts</u> (unidentified)	11900	5100				
<u>Monostyla</u> spp.	2600	100				
<u>Notholca</u> <u>acuminata</u>	100					
<u>Notholca</u> <u>squamula</u>						
ARTHROPODA						
<u>Cladocera</u>						
<u>Alona</u> sp.	5					
<u>Pleuroxus</u> <u>aduncus</u>						
<u>Copepoda</u>						
<u>Nauplii</u>	1500					
<u>Cyclopoid</u> copepodites	345					
<u>Bryocamptus</u> <u>hiemalis</u>						
<u>Eucyclops</u> <u>agilis</u>	85					
<u>Ostracoda</u>						
<u>Ostracoda</u> (unidentified)	150					

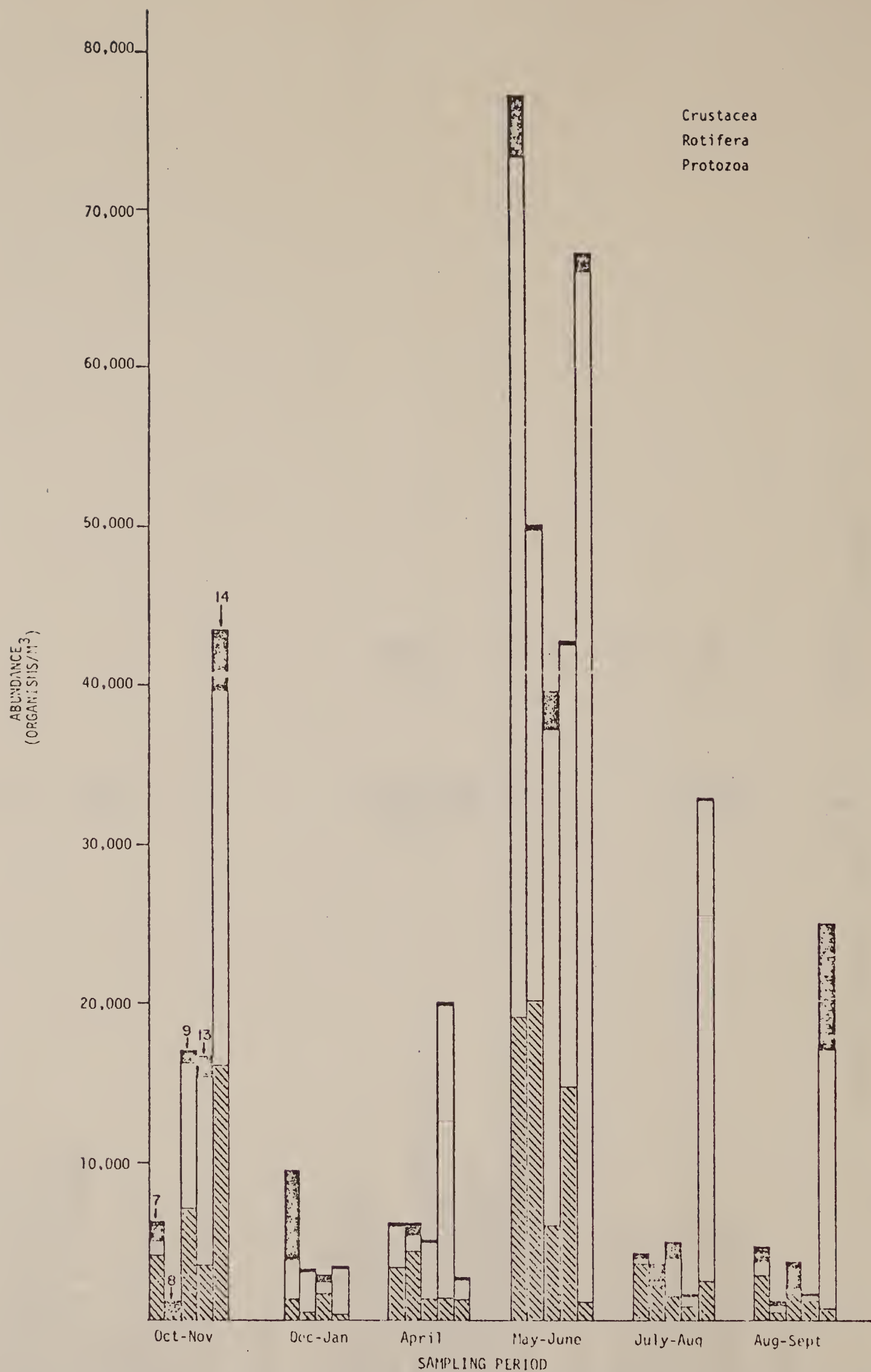


Figure 3-8-23. Zooplankton densities observed at the Tract Stations (7,8,9,13,14) which were generally flowing during RBOSP Aquatic Baseline Studies from October - November 1974 to August - September 1975. (During December 1974 - January 1975 samples were taken at Station 8, 9, 13, and 14 only.)

Table 3-8-118. Zooplankton taxa observed at the Tract Stations during RBOSP Aquatic Baseline Studies, October - November 1974 through August - September 1975.

PROTOZOA

Actinophrys sp.
Actinosphaerium eichhorni
Amoeba sp.
Centropyxis aculeata
Centropyxis arcelloides
Centropyxis constricta
Centropyxis sp.
Chilodonella cucullulus
Chilodonella sp.
ciliates (unidentified)
Cucurbitella mespiliformis
Cyphoderia ampulla
Didinium sp.
Diffugia lebes
Diffugia lobostoma
Diffugia oblonga
Diffugia sp.
Dileptus sp.
Dinamoeba mirabilis
Epistylis sp.
Euglypha compressa
Lacrymaria sp.
Paramecium sp.
Strobilidium sp.
Strombidium sp.
Trinema enchelys
Trochilia sp.
Vorticella sp.

ROTIFERA

bdelloidea (unidentified)
Brachionus quadridentatus
Cephalodella forficula
Cephalodella gibba
Cephalodella sp.
Colurella adriatica
Colurella dicentra
Colurella sp.
Euchlanis dilatata
Gastropus sp.
Keratella cochlearis
Lecane luna

Table 3-8-118. Continued.

ROTIFERA (Cont.)

Lecane sp.
Lepadella patella
Lepadella sp.
monogont (unidentified)
Monostyla bulla
Monostyla closterocerca
Monostyla lunaris
Monostyla sp.
Notholca acuminata
Notholca squamula
Proales sp.
Rotaria sp.
Trichotria pocillum

TARDIGRADA

ARTHROPODA

Crustacea
Amphipoda
Hyalella azteca
Cladocera
Alona circumfimbriata
Ceriodaphnia sp.
Chydorus sphaericus
Pleuroxus aduncus
Scapholeberis kingi
Simocephalus vetulus
Copepoda
Nauplii
Cyclopoid copepodites
Harpacticoid copepodites
Bryocamptus hiemalis
Cyclops vernalis
Eucyclops agilis
Harpacticoida sp. (unidentified)
Paracyclops fimbriatus poppei
Ostracoda
Ostracoda (unidentified)

November. During this sampling, a large shallow pool choked with filamentous algae was located just above the sampling location. In later months, due to high flows and silting, the pool was filled with sand.

Crustacean densities ranged from no organisms (Station 17 in August) to 7,965/m³ (Station 14 in August). Crustacean taxa included 1 Amphipoda, 6 Cladocera, 1 Harpacticoida, 3 Cyclopoida and possibly more than 1 Ostracoda. Copepod nauplii, Bryocamptus hiemalis and ostracods were the dominant taxa at the spring-brook stations (7-9 and 13) throughout the year. Small numbers of cladocerans and cyclopoids also occurred, predominantly in the summer and fall. Station 14 differed considerably from the other stations on or near tract in both crustacean species and numbers. The dominant species, Ceriodaphnia quadrangula, had densities of 3,552 and 5,880/m³ in October-November and August-September, respectively. Eucyclops agilis was the most abundant cyclopoid. Alona circumfimbriata and Pleuroxus aduncus each occurred in small numbers at several of the stations. Alona was rare and Pleuroxus was absent at Station 14.

c. Yellow Creek - Zooplankton densities at Yellow Creek stations (Tables 3-8-119 to 3-8-124) varied from 940/m³ in December-January to 60,660/m³ in May-June; both minimum and maximum densities occurred at Station 19 (Figure 3-8-24). Taxa observed included 16 Protozoa, 16 Rotifera, 15 Crustacea and several unidentified forms in each group (Table 3-3-125).

Protozoan densities were low throughout the year at Station 19; they ranged from 500/m³ in December-January to 2,200/m³ in October-November. Lower Yellow Creek stations (20-22) showed a wider range of densities, from 300/m³ in August (Station 22) to 8,200/m³ in April (Station 20). Protozoan densities were below 800/m³ at all stations in August. Centropyxis spp. were the dominant taxa throughout the year at all stations.

Rotifer densities varied considerably, ranging from none at Station 22 in April to 58,300/m³ at Station 19 in June. Rotifer densities had the greatest seasonal variations at Station 19, where densities peaked in the

Table 3-8-119. Mean densities of the major zooplankton observed at the Yellow Creek Stations during RBOSP Aquatic Baseline Studies, October - November 1975. (Data are expressed as organisms/m³ and are the means of duplicate samples.)

	Station			
	19	20	21	22
PROTOZOA				
<u>Centropyxis</u> spp.	1400	500	1800	2200
<u>ciliates</u> (misc.)	500	200	200	100
<u>Diffflugia</u> spp.				100
<u>Epistylis</u> spp.				
<u>Vorticella</u> spp.	300	300	400	
ROTIFERA				
<u>bdelloidea</u> (unidentified)	800			300
<u>Cephalodella</u> spp.	300	600	900	600
<u>Colurella</u> <u>adriatica</u>				
<u>Lepadella</u> <u>patella</u>	1000	500	100	300
<u>monogononts</u> (unidentified)	700	200	200	400
<u>Monostyla</u> spp.	1900	300	500	600
<u>Notholca</u> <u>acuminata</u>	9200	6500	2900	2500
<u>Notholca</u> <u>squamula</u>	400	100		
ARTHROPODA				
Cladocera				
<u>Alona</u> sp.	307	12	6	
<u>Pleuroxus</u> <u>aduncus</u>	828			
Copepoda				
<u>Nauplii</u>	900	100	100	100
<u>Cyclopoid</u> copepodites	1711	18	18	24
<u>Bryocamptus</u> <u>hiemalis</u>				
<u>Eucyclops</u> <u>agilis</u>	24	12	18	6
Ostracoda				
Ostracoda (unidentified)	72		6	6

Table 3-8-120. Mean densities of the major zooplankton observed at the Yellow Creek Stations during RBOSP Aquatic Baseline Studies, December 1974 - January 1975. (Data are expressed as organisms/m³ and are the means of duplicate samples.)

	Station			
	<u>19</u>	<u>20</u>	<u>21</u>	<u>22</u>
PROTOZOA				
<u>Centropyxis</u> spp.	400	2000	2500	700
<u>ciliates</u> (misc.)		100	400	100
<u>Diffflugia</u> spp.	100			
<u>Epistylis</u> spp.				
<u>Vorticella</u> spp.				
ROTIFERA				
<u>bdelloidea</u> (unidentified)			100	
<u>Cephalodella</u> spp.		200	100	100
<u>Colurella adriatica</u>		100		100
<u>Lepadella patella</u>		500	100	
<u>monogononts</u> (unidentified)				300
<u>Monostyla</u> spp.		1300	1500	400
<u>Notholca acuminata</u>	400	800	300	600
<u>Notholca squamula</u>		100		
ARTHROPODA				
Cladocera				
<u>Alona</u> sp.				
<u>Pleuroxus aduncus</u>				5
Copepoda				
<u>Nauplii</u>		400	100	
<u>Cyclopoid copepodites</u>	15	5	15	
<u>Bryocamptus hiemalis</u>			5	
<u>Eucyclops agilis</u>	25			
Ostracoda				
<u>Ostracoda</u> (unidentified)		10		5

Table 3-8-12i. Mean densities of the major zooplankton observed at the Yellow Creek Stations during RBOSP Aquatic Baseline Studies, April 1975. (Data are expressed as organisms/m³ and are the means of duplicate samples.)

	Station			
	<u>19</u>	<u>20</u>	<u>21</u>	<u>22</u>
PROTOZOA				
<u>Centropyxis</u> spp.	200	7300	4800	3700
<u>ciliates</u> (misc.)			200	100
<u>Diffugia</u> spp.		600	300	300
<u>Epistylis</u> spp.		200	1400	
<u>Vorticella</u> spp.	600	100	100	
ROTIFERA				
<u>bdelloidea</u> (unidentified)	400		300	
<u>Cephalodella</u> spp.				
<u>Colurella</u> <u>adriatica</u>			300	
<u>Lepadella</u> <u>patella</u>				
<u>monogononts</u> (unidentified)	500		200	
<u>Monostyla</u> spp.	200	100	100	
<u>Notholca</u> <u>acuminata</u>	1000	100		
<u>Notholca</u> <u>squamula</u>	100		100	
ARTHROPODA				
Cladocera				
<u>Alona</u> sp.	5			
<u>Pleuroxus</u> <u>aduncus</u>				
Copepoda				
<u>Nauplii</u>	400		300	
<u>Cyclopoid</u> copepodites			95	
<u>Bryocamptus</u> <u>hiemalis</u>				
<u>Eucyclops</u> <u>agilis</u>	20	15	15	5
Ostracoda				
Ostracoda (unidentified)	15	20	35	30

Table 3-8-122. Mean densities of the major zooplankton observed at the Yellow Creek Stations during RBOSP Aquatic Baseline Studies, May - June 1975.. (Data are expressed as organisms/m³ and are the means of duplicate samples.)

	Station			
	<u>19</u>	<u>20</u>	<u>21</u>	<u>22</u>
PROTOZOA				
<u>Centropyxis</u> spp.	1200	200	700	
<u>ciliates</u> (misc.)	300	100		
<u>Diffugia</u> spp.	500	100	100	
<u>Epistylis</u> spp.				
<u>Vorticella</u> spp.			100	
ROTIFERA				
<u>bdelloidea</u> (unidentified)	800			
<u>Cephalodella</u> spp.	1200			100
<u>Colurella</u> <u>adriatica</u>		600	300	300
<u>Lepadella</u> <u>patella</u>	8300	300		
<u>monogononts</u> (unidentified)	500		200	
<u>Monostyla</u> spp.	1000	200		
<u>Notholca</u> <u>acuminata</u>	20900			1000
<u>Notholca</u> <u>squamula</u>	20200			200
ARTHROPODA				
Cladocera				
<u>Alona</u> sp.				
<u>Pleuroxus</u> <u>aduncus</u>	20			
Copepoda				
Nauplii		100	100	500
Cyclopoid copepodites	100	20		70
<u>Bryocamptus</u> <u>hiemalis</u>	30			
<u>Eucyclops</u> <u>agilis</u>		20	15	25
Ostracoda				
Ostracoda (unidentified)	150	5		80

Table 3-8-123. Mean densities of the major zooplankton observed at the Yellow Creek Stations during RBOSP Aquatic Baseline Studies, July - August 1975. (Data are expressed as organisms/m³ and are the means of duplicate samples.)

	Station			
	<u>19</u>	<u>20</u>	<u>21</u>	<u>22</u>
PROTOZOA				
<u>Centropyxis</u> spp.	600	4000	700	400
<u>ciliates</u> (misc.)				
<u>Diffugia</u> spp.		100		
<u>Epistylis</u> spp.				
<u>Vorticella</u> spp.	100			
ROTIFERA				
<u>bdelloidea</u> (unidentified)				
<u>Cephalodella</u> spp.				
<u>Colurella</u> <u>adriatica</u>				
<u>Lepadella</u> <u>patella</u>				
<u>monogononts</u> (unidentified)	800	100	100	100
<u>Monostyla</u> spp.	100			
<u>Notholca</u> <u>acuminata</u>				
<u>Notholca</u> <u>squamula</u>	100			
ARTHROPODA				
Cladocera				
<u>Alona</u> sp.	5	5		
<u>Pleuroxus</u> <u>aduncus</u>	5	300	230	70
Copepoda				
<u>Nauplii</u>	100	300		400
<u>Cyclopoid</u> copepodites	50	40	75	455
<u>Bryocamptus</u> <u>hiemalis</u>				
<u>Eucyclops</u> <u>agilis</u>	190	1160	405	600
Ostracoda				
<u>Ostracoda</u> (unidentified)	270	5	5	

Table 3-8-124. Mean densities of the major zooplankton observed at the Yellow Creek Stations during RBOSP Aquatic Baseline Studies, August - September 1975. (Data are expressed as organisms/m³ and are the means of duplicate samples.)

	Station			
	<u>19</u>	<u>20</u>	<u>21</u>	<u>22</u>
PROTOZOA				
<u>Centropyxis</u> spp.	100	100	100	
<u>ciliates</u> (misc.)	300	100		
<u>Diffugia</u> spp.	100	600	500	300
<u>Epistylis</u> spp.				
<u>Vorticella</u> spp.	200			
ROTIFERA				
<u>bdelloidea</u> (unidentified)	3300			100
<u>Cephalodella</u> spp.	100		100	
<u>Colurella</u> <u>adriatica</u>	100	2400	2600	1900
<u>Lepadella</u> <u>patella</u>	1200			
<u>monogononts</u> (unidentified)	900	200	500	400
<u>Monostyla</u> spp.	1100	200	300	100
<u>Notholca</u> <u>acuminata</u>				
<u>Notholca</u> <u>squamula</u>				
ARTHROPODA				
Cladocera				
<u>Alona</u> sp.	3920	30	15	
<u>Pleuroxus</u> <u>aduncus</u>	425	5280	4820	375
Copepoda				
<u>Nauplii</u>	200	800	500	1900
<u>Cyclopoid</u> copepodites	725	430	370	410
<u>Bryocamptus</u> <u>hiemalis</u>	5			
<u>Eucyclops</u> <u>agilis</u>	105	1720	655	785
Ostracoda				
Ostracoda (unidentified)	65		35	10

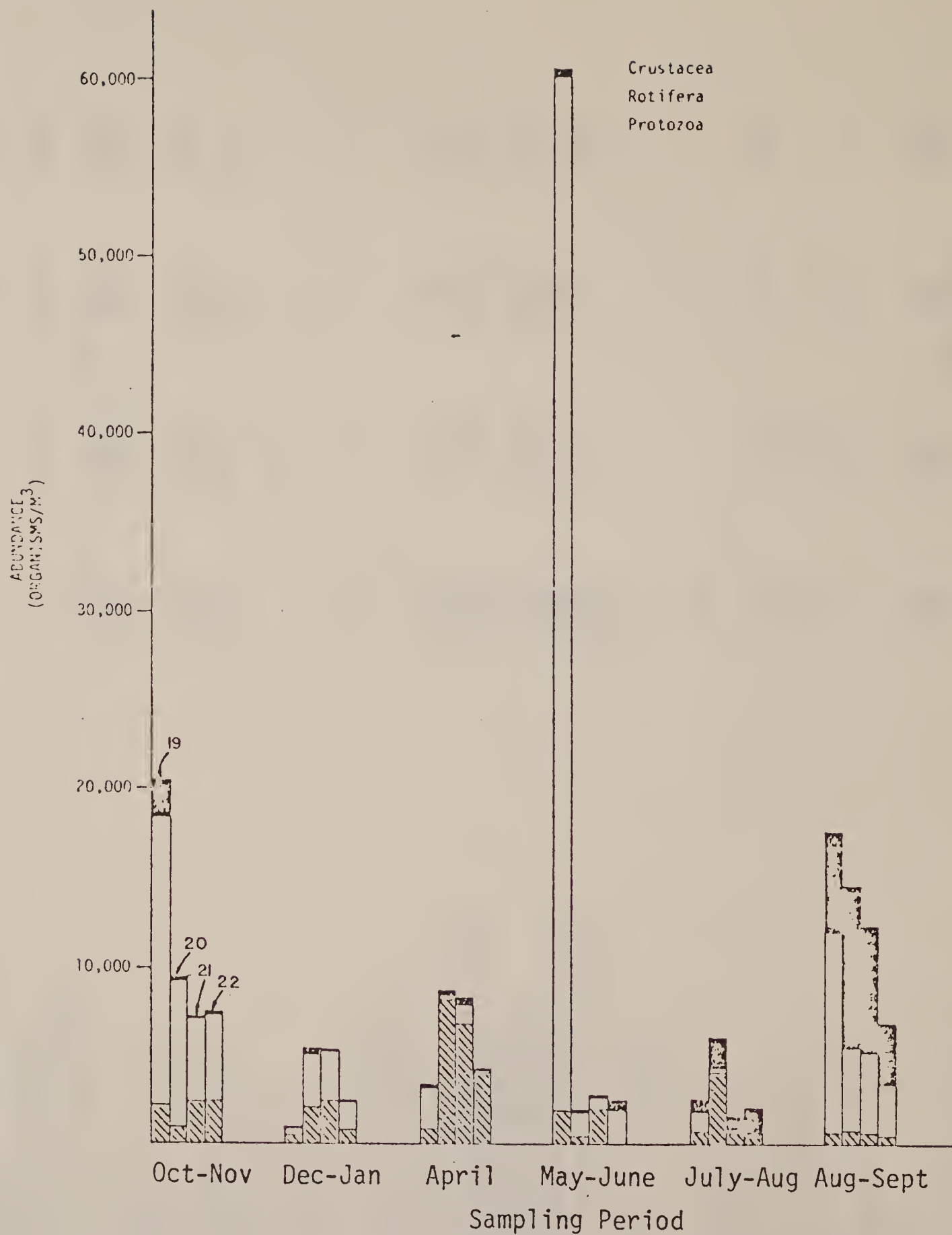


Figure 3-8-24. Zooplankton densities observed at the Yellow Creek Stations (19-22) during RBOSP Aquatic Baseline Studies from October - November 1974 to August - September 1975.

Table 3-8-125. Zooplankton taxa observed at the Yellow Creek Stations during RBOSP Aquatic Baseline Studies, October - November 1974 through August - September 1975.

PROTOZOA

Bresslaua sp.
Centropyxis aculeata
Centropyxis arcelloides
Centropyxis constricta
Chilodonella cucullulus
Chilodonella sp.
ciliates (unidentified)
Diffugia acuminata
Diffugia Tebes
Diffugia Tobostoma
Diffugia oblonga
Diffugia sp.
Dileptus sp.
Epistylis sp.
Orthodon sp.
Paramecium aurelia
Paramecium caudatum
Strobilidium sp.
Vorticella sp.

ROTIFERA

bdelloidea (unidentified)
Brachionus quadridentatus
Cephalodella forficula
Cephalodella gibba
Cephalodella sp.
Glurella adriatica
Colurella sp.
Euchlanis dilatata
Gastropus sp.
Lecane luna
Lecane sp.
Lepadella patella
Lepadella sp.
monogononts (unidentified)
Monostyla bulla
Monostyla closterocerca
Monostyla lunaris
Monostyla quadridentata
Monostyla sp.
Notholca acuminata
Notholca squamula
Proales sp.
Trichotria pocillum

Table 3-8-125. Continued.

ARTHROPODA

Crustacea

Amphipoda

Hyalella azteca

Cladocera

Alona barbulata

Alona circumfimbriata

Alona sp.

Ceriodaphnia quadrangula

Ceriodaphnia sp.

Chydorus sphaericus

Daphnia sp.

Moina sp.

Pleuroxus aduncus

Simocephalus vetulus

Copepoda

Nauplii

Cyclopoid copepodites

Bryocamptus hiemalis

Cyclops vernalis

Eucyclops agilis

Eucyclops speratus

Harpacticoida sp. (unidentified)

Paracyclops fimbriatus poppei

Ostracoda

Ostracoda (unidentified)

months of October, June and August with 14,300, 58,300 and 11,400/m³, respectively. Densities never exceeded 2,400/m³ in other months. Peak densities at the lower stations (20-22) occurred in October and August (4,600-8,200 and 3,000-4,700/m³, respectively). Lowest numbers occurred in April and July-August (less than 200/m³).

The greatest diversity of rotifer fauna (predominantly littoral forms), occurred at Station 19. Notholca acuminata, a planktonic species often found in littoral habitats (Ruttner-Kolisko, 1974), was most numerous from October to June, with densities of 9,200 and 20,900/m³ in those months and much smaller numbers in other months. Bdelloids, Cephalodella, Lepadella, Monostyla and Notholca squamula occurred in most months at all stations; highest densities occurred in June at Station 19. Euchlanis dilatata and Lecane luna were also abundant at Station 19 in June. In July, there were few species; contracted monogononts were common at all stations. In August-September, rotifers increased again; bdelloids and Euchlanis dilatata were the dominant taxa at Station 19 and Colurella adriatica was the most abundant species at the lower stations.

Crustacea were abundant only in October-November, July-August and August-September. Densities varied from as few as 10/m³ at Station 22 in December-January to 9,060/m³ at Station 20 in August-September. Immature copepods and ostracods were the major crustaceans in months of low abundance. The late summer (August-September) peaks were due primarily to high densities of Alona (predominantly circumfimbriata) at Stations 20-22 (375-5,280/m³ and 655-1,720/m³, respectively). Other taxa present throughout the year, but in much lower numbers, included Chydorus sphaericus, Simocephalus vetulus, Ceriodaphnia quadrangula, Cyclops vernalis, Eucyclops speratus and Paracyclops fimbriatus poppei.

d. White River - Zooplankton densities for the three study areas of the White River (above, below and near the confluence with Yellow Creek) (Tables 3-8-126 through 3-8-131) are shown in Figure 3-8-25. Mean total densities ranged from 6,268/m³ near the confluence in June to more than

Table 3-8-126. Mean densities of the major zooplankton observed at the White River Stations during RBOSP Aquatic Baseline Studies, October - November 1974. (Data are expressed as organisms/m³ and are the means of duplicate samples.)

	Above Confluence with Yellow Creek				
	23	24	25	26	27
PROTOZOA					
<u>Centropyxis</u> spp.	4400	8800	8900	7400	7100
<u>ciliates</u> (misc.)	100	100			100
<u>Diffflugia</u> spp.	400	200	100	200	100
<u>Epistylis</u> spp.	1200	300	1200		2800
<u>Vorticella</u> spp.	4400	1600	3100	1000	4400
ROTIFERA					
<u>bdelloidea</u> (unidentified)	700	400	200		200
<u>Cephalodella</u> spp.	1400	400	800	400	1100
<u>Colurella</u> <u>adriatica</u>	200		100	100	
<u>Lepadella</u> <u>patella</u>	900	500	1000	1000	600
<u>monogononts</u> (unidentified)	200	300			300
<u>Monostyla</u> spp.	800	600	1000	700	300
<u>Notholca</u> <u>acuminata</u>		100			
<u>Notholca</u> <u>squamula</u>	100	100			
ARTHROPODA					
Cladocera					
<u>Alona</u> sp.					
<u>Pleuroxus</u> <u>aduncus</u>					
Copepoda					
Nauplii			100	100	100
Cyclopoid copepodites	10	10			
<u>Bryocamptus</u> <u>hiemalis</u>					
<u>Eucyclops</u> <u>agilis</u>	5				
Ostracoda					
Ostracoda (unidentified)					

Table 3-8-126. Continued.

At Confluence with Yellow Creek		
	Station	
	28	29
PROTOZOA		
<u>Centropyxis</u> spp.	7800	3800
<u>ciliates</u> (misc.)	100	
<u>Diffugia</u> spp.		100
<u>Epistylis</u> spp.		
<u>Vorticella</u> spp.	1600	700
ROTIFERA		
<u>bdelloidea</u> (unidentified)		100
<u>Cephalodella</u> spp.	700	100
<u>Colurella</u> <u>adriatica</u>		
<u>Lepadella</u> <u>patella</u>	700	300
<u>monogononts</u> (unidentified)		100
<u>Monostyla</u> spp.	500	400
<u>Notholca</u> <u>acuminata</u>	100	100
<u>Notholca</u> <u>squamula</u>	100	100
ARTHROPODA		
Cladocera		
<u>Alona</u> sp.		
<u>Pleuroxus</u> <u>aduncus</u>		
Copepoda		
Nauplii	100	
Cyclopoid copepodites		
<u>Bryocamptus</u> <u>hiemalis</u>		
<u>Eucyclops</u> <u>agilis</u>		
Ostracoda		
Ostracoda (unidentified)	5	

Table 3-8-126. Continued.

Below Confluence with Yellow Creek					
	Station				
	30	31	32	33	34
PROTOZOA					
Centropyxis spp.	10000	6300	7800	11500	14400
ciliates (misc.)	200			200	100
Diffugia spp.		200	100	700	500
Epistylis spp.			300	1000	300
Vorticella spp.	1400	1300	2400	2000	2600
ROTIFERA					
bdelloidea (unidentified)	100		100		200
Cephalodella spp.	400	500	500	900	1100
Colurella adriatica	100	200	600	300	
Lepadella patella	1000	500	600	900	900
monogononts (unidentified)	100	100	100	200	100
Monostyla spp.	500	800	800	1600	1100
Notholca acuminata			300		
Notholca squamula			100	100	
ARTHROPODA					
Cladocera					
Alona sp.					
Pleuroxus aduncus					
Copepoda					
Nauplii	100	100			
Cyclopoid copepodites					
Bryocamptus hiemalis					
Eucyclops agilis					
Ostracoda					
Ostracoda (unidentified)	5		5		

Table 3-8-126. Continued.

Below Confluence with Yellow Creek (Cont.)

Station

35

PROTOZOA

<u>Centropyxis</u> spp.	
<u>ciliates</u> (misc.)	9100
<u>Diffugia</u> spp.	100
<u>Epistylis</u> spp.	100
<u>Vorticella</u> spp.	1200

ROTIFERA

<u>bdelloidea</u> (unidentified)	200
<u>Cephalodella</u> spp.	500
<u>Colurella</u> <u>adriatica</u>	200
<u>Lepadella</u> <u>patella</u>	1400
<u>monogononts</u> (unidentified)	100
<u>Monostyla</u> spp.	1400
<u>Notholca</u> <u>acuminata</u>	
<u>Notholca</u> <u>squamula</u>	

ARTHROPODA

Cladocera	
<u>Alona</u> sp.	
<u>Pleuroxus</u> <u>aduncus</u>	
Copepoda	
Nauplii	
Cyclopoid copepodites	
<u>Bryocamptus</u> <u>hiemalis</u>	
<u>Eucyclops</u> <u>agilis</u>	
Ostracoda	
Ostracoda (unidentified)	

Table 3-8-127. Mean densities of the major zooplankton taxa observed at the White River Stations during RBOSP Aquatic Baseline Studies, December 1974 - January 1975. (Data are expressed as organisms/m³ and are the means of duplicate samples.)

	Above Confluence with Yellow Creek		Station	
	<u>23</u>	<u>24</u>	<u>25</u>	<u>26</u>
PROTOZOA				
<u>Centropyxis</u> spp.	10900	8900	9100	6500
<u>ciliates</u> (misc.)	400		800	600
<u>Diffugia</u> spp.	300	200	300	300
<u>Epistylis</u> spp.	300	200	1200	
<u>Vorticella</u> spp.	1800	3300	3100	5000
ROTIFERA				
<u>bdelloidea</u> (unidentified)	200	1000	1100	600
<u>Cephalodella</u> spp.	200	500	200	200
<u>Colurella</u> <u>adriatica</u>	100	500	600	100
<u>Lepadella</u> <u>patella</u>	7700	6800	7400	6100
<u>monogononts</u> (unidentified)	100	400	500	1100
<u>Monostyla</u> spp.			100	100
<u>Notholca</u> <u>acuminata</u>		100	500	200
<u>Notholca</u> <u>squamula</u>				
ARTHROPODA				
<u>Cladocera</u>				5
<u>Alona</u> sp.				
<u>Pleuroxus</u> <u>aduncus</u>				
<u>Copepoda</u>				
<u>Nauplii</u>		200	200	
<u>Cyclopoid</u> copepodites		5		5
<u>Bryocamptus</u> <u>hiemalis</u>				
<u>Eucyclops</u> <u>agilis</u>	10	15	10	10
<u>Ostracoda</u>				
<u>Ostracoda</u> (unidentified)				

Table 3-8-127. Continued

	Below Confluence with Yellow Creek					Station				
	30	31	32	33	34	30	31	32	33	34
PROTOZOA										
<u>Centropyxis</u> spp.	3000	7500	3300	1600	4000					
<u>ciliates</u> (misc.)	1250	1000	100	500	600					
<u>Diffugia</u> spp.					100					
<u>Epistylis</u> spp.	3000	750	700	2100	100					
<u>Vorticella</u> spp.	9000	12500	2100	600	900					
ROTIFERA										
<u>bdelloidea</u> (unidentified)										
<u>Cephalodella</u> spp.	750	1750	300	200	300					
<u>Colurella</u> <u>adriatica</u>	1250		700							
<u>Lepadella</u> <u>patella</u>				500	200					
<u>monogononts</u> (unidentified)	250	4500	4600	4300	3100					
<u>Monostyla</u> spp.	250		600		100					
<u>Notholca</u> <u>acuminata</u>	500				100					
<u>Notholca</u> <u>squamula</u>	500		100	300	100					
ARTHROPODA										
Cladocera										
<u>Alona</u> sp.				5						
<u>Pleuroxus</u> <u>aduncus</u>										
Copepoda										
Nauplii			100							
Cyclopoid copepodites			5		5					
<u>Bryocamptus</u> <u>hiemalis</u>										
<u>Eucyclops</u> <u>agilis</u>										
Ostracoda										
Ostracoda (unidentified)				60	5					

Table 3-8-127. Continued

Below Confluence with Yellow Creek (Cont.)		Station
		35
PROTOZOA		
<u>Centropyxis</u> spp.	4300	
<u>Ciliates</u> spp.	1000	
<u>Diffugia</u> spp.	100	
<u>Epistylis</u> spp.	3100	
<u>Vorticella</u> spp.	400	
ROTIFERA		
<u>Bdelloidea</u> spp. (Contracted)	100	
<u>Cephalodella</u> spp.	500	
<u>Colurella</u> <u>adriatica</u>	300	
<u>Lepadella</u> sp.	100	
<u>Monogononta</u> spp. (Contracted)	5800	
<u>Monostyla</u> spp.	200	
<u>Notholca</u> <u>acuminata</u>	100	
<u>Notholca</u> <u>squamula</u>	300	
ARTHROPODA		
Crustacea		
Cladocerca		
<u>Alona</u> sp.		
<u>Pleuroxus</u> <u>aduncus</u>		
Copepoda		
<u>Nauplii</u>	100	
<u>Cyclopoid</u> copepodites		
<u>Bryocamptus</u> <u>hiemalis</u>		
<u>Eucyclops</u> <u>agilis</u>		
Ostracoda		
Ostracoda spp.		

Table 3-8-128. Mean densities of the major zooplankton taxa observed at the White River Stations during RBOSP Aquatic Baseline Studies, April 1975. (Data are expressed as organisms/m³ and are the means of duplicate samples.)

	Above Confluence with Yellow Creek				
	Station 23	24	25	26	27
PROTOZOA					
<u>Centropyxis</u> spp.	1900	3200	3000	2500	2800
<u>ciliates</u> (misc.)	1700	800	200	400	
<u>Diffugia</u> spp.		200	200	1100	
<u>Epistylis</u> spp.	700	5000	400	700	2800
<u>Vorticella</u> spp.	8300	400	500	200	1400
ROTIFERA					
<u>bdelloidea</u> (unidentified)	700		200	500	400
<u>Cephalodella</u> spp.		200		100	
<u>Colurella adriatica</u>	200			100	
<u>Lepadella patella</u>					
<u>monogononts</u> (unidentified)	2000	2400	800	500	1100
<u>Monostyla</u> spp.	100				
<u>Notholca acuminata</u>		200	100	100	200
<u>Notholca squamula</u>	1200	1100	200	500	700
ARTHROPODA					
Cladocera					
<u>Alona</u> sp.					
<u>Pleuroxus aduncus</u>					
Copepoda					
<u>Nauplii</u>		100			
<u>Cyclopoid copepodites</u>	10	5	5		
<u>Bryocamptus hiemalis</u>					
<u>Eucyclops agilis</u>					
Ostracoda					
<u>Ostracoda</u> (unidentified)	5	10	5	20	25

Table 3-8-128. Continued.

At Confluence with Yellow Creek	Station	
	28	29
PROTOZOA		
<u>Centropyxis</u> spp.	3800	2300
<u>ciliates</u> (misc.)		700
<u>Diffugia</u> spp.	400	
<u>Epistylis</u> spp.	500	600
<u>Vorticella</u> spp.	5500	
ROTIFERA		
<u>bdelloidea</u> (unidentified)	500	400
<u>Cephalodella</u> spp.	100	100
<u>Colurella</u> <u>adriatica</u>		300
<u>Lepadella</u> <u>patella</u>		
<u>monogononts</u> (unidentified)	600	1900
<u>Monostyla</u> spp.	100	
<u>Notholca</u> <u>acuminata</u>	100	
<u>Notholca</u> <u>squamula</u>	200	900
ARTHROPODA		
Cladocera		
<u>Alona</u> sp.		5
<u>Pleuroxus</u> <u>aduncus</u>		5
Copepoda		
Nauplii	200	100
Cyclopoid copepodites	5	
<u>Bryocamptus</u> <u>hiemalis</u>		
<u>Eucyclops</u> <u>agilis</u>		10
Ostracoda		
Ostracoda (unidentified)		

Table 3-8-128. Continued.

Below Confluence with Yellow Creek					
	Station				
	30	31	32	33	34
PROTOZOA					
<u>Centropyxis</u> spp.	4900	6800	4800	10600	8200
<u>ciliates</u> (misc.)	1000	500	300	800	500
<u>Diffugia</u> spp.			200	300	400
<u>Epistylis</u> spp.	300	300	1600	1200	1300
<u>Vorticella</u> spp.	1400	1000	1300	2500	1100
ROTIFERA					
<u>bdelloidea</u> (unidentified)	100	600	500	1000	500
<u>Cephalodella</u> spp.	100		200	100	100
<u>Colurella</u> <u>adriatica</u>			100	100	
<u>Lepadella</u> <u>patella</u>					
<u>monogononts</u> (unidentified)	300	300	400	500	1700
<u>Monostyla</u> spp.		100	100		
<u>Notholca</u> <u>acuminata</u>	200	100	200		
<u>Notholca</u> <u>squamula</u>	200	600	200	400	300
ARTHROPODA					
Cladocera					
<u>Alona</u> sp.					
<u>Pleuroxus</u> <u>aduncus</u>					
Copepoda					
Nauplii					
			300		
Cyclopoid copepodites					
				5	5
<u>Bryocamptus</u> <u>hiemalis</u>					
<u>Eucyclops</u> <u>agilis</u>					
		5			
Ostracoda					
Ostracoda (unidentified)					
				5	

Table 3-8-128. Continued.

Below Confluence with Yellow Creek (Cont.)		Station
		<u>35</u>
PROTOZOA		
<u>Centropyxis</u> spp.		6600
<u>ciliates</u> (misc.)		600
<u>Diffugia</u> spp.		100
<u>Epistylis</u> spp.		1300
<u>Vorticella</u> spp.		1700
ROTIFERA		
<u>bdelloidea</u> (unidentified)		100
<u>Cephalodella</u> spp.		200
<u>Colurella adriatica</u>		200
<u>Lepadella patella</u>		
<u>monogononts</u> (unidentified)		800
<u>Monostyla</u> spp.		100
<u>Notholca acuminata</u>		
<u>Notholca squamula</u>		1200
ARTHROPODA		
Cladocera		
<u>Alona</u> sp.		
<u>Pleuroxus aduncus</u>		
Copepoda		
Nauplii		100
Cyclopoid copepodites		
<u>Bryocamptus hiemalis</u>		
<u>Eucyclops agilis</u>		
Ostracoda		
Ostracoda (unidentified)		

Table 3-8-129. Mean densities of the major zooplankton taxa observed at the White River Stations during RBOSP Aquatic Baseline Studies, May - June 1975. (Data are expressed as organisms/m³ and are the means of duplicate samples.)

	Above Confluence with Yellow Creek				
	Station				
	<u>23</u>	<u>24</u>	<u>25</u>	<u>26</u>	<u>27</u>
PROTOZOA					
<u>Centropyxis</u> spp.	3600	9200	3600	5300	5300
<u>ciliates</u> (misc.)			100	100	
<u>Diffugia</u> spp.	200	1200		100	100
<u>Epistylis</u> spp.		100	400	300	
<u>Vorticella</u> spp.				300	
ROTIFERA					
<u>bdelloidea</u> (unidentified)	200	100	500	200	100
<u>Cephalodella</u> spp.					
<u>Colurella</u> <u>adriatica</u>					
<u>Lepadella</u> <u>patella</u>					
<u>monogononts</u> (unidentified)			100		300
<u>Monostyla</u> spp.	400	200		200	100
<u>Notholca</u> <u>acuminata</u>					
<u>Notholca</u> <u>squamula</u>	200	100	600	200	
ARTHROPODA					
Cladocera					
<u>Alona</u> sp.					
<u>Pleuroxus</u> <u>aduncus</u>					
Copepoda					
<u>Nauplii</u>	300	200	200		
<u>Cyclopoid</u> copepodites			5		10
<u>Bryocamptus</u> <u>hiemalis</u>					
<u>Eucyclops</u> <u>agilis</u>					
Ostracoda					
Ostracoda (unidentified)		15			5

Table 3-8-129. Continued

At Confluence with Yellow Creek

	Station	
	<u>28</u>	<u>29</u>
PROTOZOA		
<u>Centropyxis</u> spp.	4700	4700
<u>ciliates</u> (misc.)	100	
<u>Diffugia</u> spp.		100
<u>Epistylis</u> spp.		500
<u>Vorticella</u> spp.		200
ROTIFERA		
<u>bdelloidea</u> (unidentified)		100
<u>Cephalodella</u> spp.		
<u>Colurella</u> <u>adriatica</u>		
<u>Lepadella</u> <u>patella</u>		
<u>monogononts</u> (unidentified)	200	200
<u>Monostyla</u> spp.	100	
<u>Notholca</u> <u>acuminata</u>		
<u>Notholca</u> <u>squamula</u>	200	200
ARTHROPODA		
Cladocera		
<u>Alona</u> sp.		
<u>Pleuroxus</u> <u>aduncus</u>		
Copepoda		
<u>Nauplii</u>	500	100
<u>Cyclopoid</u> copepodites	10	
<u>Bryocamptus</u> <u>hiemalis</u>		
<u>Eucyclops</u> <u>agilis</u>		
Ostracoda		
Ostracoda (unidentified)	10	10

Table 3-8-129. Continued.

	Below Confluence with Yellow Creek				
	Station				
	<u>30</u>	<u>31</u>	<u>32</u>	<u>33</u>	<u>34</u>
PROTOZOA					
<u>Centropyxis</u> spp.	6800	9900	6700	7500	6900
<u>ciliates</u> (misc.)				100	
<u>Diffugia</u> spp.	200	300	800		1100
<u>Epistylis</u> spp.					
<u>Vorticella</u> spp.	100				100
ROTIFERA					
<u>bdelloidea</u> (unidentified)	100	500	400	100	300
<u>Cephalodella</u> spp.					
<u>Colurella</u> <u>adriatica</u>					
<u>Lepadella</u> <u>patella</u>					
<u>monogononts</u> (unidentified)	100	100	100	100	100
<u>Monostyla</u> spp.					
<u>Notholca</u> <u>acuminata</u>		100	100	100	
<u>Notholca</u> <u>squamula</u>		100	100		100
ARTHROPODA					
Cladocera					
<u>Alona</u> sp.					
<u>Pleuroxus</u> <u>aduncus</u>					
Copepoda					
<u>Nauplii</u>		500		100	
<u>Cyclopoid</u> copepodites				5	5
<u>Bryocamptus</u> <u>hiemalis</u>					
<u>Eucyclops</u> <u>agilis</u>					
Ostracoda					
<u>Ostracoda</u> (unidentified)	10	15	5	10	5

Table 3-8-129. Continued.

Below Confluence with Yellow Creek

Station

35

PROTOZOA

<u>Centropyxis</u> spp.	14100
<u>ciliates</u> (misc.)	
<u>Diffugia</u> spp.	200
<u>Epistylis</u> spp.	
<u>Vorticella</u> spp.	

ROTIFERA

<u>bdelloidea</u> (unidentified)	
<u>Cephalodella</u> spp.	100
<u>Colurella</u> <u>adriatica</u>	
<u>Lepadella</u> <u>patella</u>	
<u>monogononts</u> (unidentified)	200
<u>Monostyla</u> spp.	
<u>Notholca</u> <u>acuminata</u>	
<u>Notholca</u> <u>squamula</u>	100

ARTHROPODA

<u>Cladocera</u>	
<u>Alona</u> sp.	
<u>Pleuroxus</u> <u>aduncus</u>	
<u>Copepoda</u>	
<u>Nauplii</u>	300
<u>Cyclopoid</u> copepodites	
<u>Bryocamptus</u> <u>hiemalis</u>	
<u>Eucyclops</u> <u>agilis</u>	
<u>Ostracoda</u>	
<u>Ostracoda</u> (unidentified)	

Table 3-8-130. Mean densities of the major zooplankton taxa observed at the White River Stations during RBOSP Aquatic Baseline Studies, July - August 1975. (Data are expressed as organisms/m³ and are the means of duplicate samples.)

	Above Confluence with Yellow Creek		Station		
	<u>23</u>	<u>24</u>	<u>25</u>	<u>26</u>	<u>27</u>
PROTOZOA					
<u>Centropyxis</u> spp.	1900	2000	2700	2800	2400
<u>ciliates</u> (misc.)	100	100	900	100	
<u>Diffugia</u> spp.	300	200	100	100	400
<u>Epistylis</u> spp.	200	800	600		1600
<u>Vorticella</u> spp.				100	
ROTIFERA					
<u>bdelloidea</u> (unidentified)				100	100
<u>Cephalodella</u> spp.	700	300	200	300	200
<u>Colurella</u> <u>adriatica</u>		100		100	
<u>Lepadella</u> <u>patella</u>	500			100	200
<u>monogononts</u> (unidentified)	4200	2600	3100	2800	2400
<u>Monostyla</u> spp.	400	400	800	600	500
<u>Notholca</u> <u>acuminata</u>					
<u>Notholca</u> <u>squamula</u>				200	
ARTHROPODA					
Cladocera					
<u>Alona</u> sp.				20	
<u>Pleuroxus</u> <u>aduncus</u>					5
Copepoda					
Nauplii	300	500	700	300	100
Cyclopoid copepodites		30	10	10	10
<u>Bryocamptus</u> <u>hiemalis</u>					
<u>Eucyclops</u> <u>agilis</u>			25	10	
Ostracoda					
Ostracoda (unidentified)		15	5		

Table 3-8-130. Continued.

At Confluence with Yellow Creek	Station	
	<u>28</u>	<u>29</u>
PROTOZOA		
<u>Centropyxis</u> spp.	1900	900
<u>ciliates</u> (misc.)	300	
<u>Diffugia</u> spp.	100	200
<u>Epistylis</u> spp.	500	300
<u>Vorticella</u> spp.	200	
ROTIFERA		
<u>bdelloidea</u> (unidentified)	100	
<u>Cephalodella</u> spp.	700	500
<u>Colurella adriatica</u>		100
<u>Lepadella patella</u>	500	100
<u>monogononts</u> (unidentified)	2500	4100
<u>Monostyla</u> spp.	300	700
<u>Notholca acuminata</u>		
<u>Notholca squamula</u>		
ARTHROPODA		
<u>Cladocera</u>		
<u>Alona</u> sp.		10
<u>Pleuroxus aduncus</u>		
<u>Copepoda</u>		
Nauplii	100	400
Cyclopoid copepodites	10	25
<u>Bryocamptus hiemalis</u>		
<u>Eucyclops agilis</u>		
<u>Ostracoda</u>		
Ostracoda (unidentified)	10	5

Table 3-8-130. Continued.

	Below Confluence with Yellow Creek		Station		
	<u>30</u>	<u>31</u>	<u>32</u>	<u>33</u>	<u>34</u>
PROTOZOA					
<u>Centropyxis</u> spp.	2100	2200	1900	900	1100
<u>ciliates</u> (misc.)	100		100		100
<u>Diffflugia</u> spp.	200	200	200	200	200
<u>Epistylis</u> spp.	900	200	500	400	700
<u>Vorticella</u> spp.		200	100		
ROTIFERA					
<u>bdelloidea</u> (unidentified)	100				100
<u>Cephalodella</u> spp.	100	100	200	200	100
<u>Colurella</u> <u>adriatica</u>	200	100			
<u>Lepadella</u> <u>patella</u>	200	100	200	100	200
<u>monogononts</u> (unidentified)	1900	2500	2800	2900	5300
<u>Monostyla</u> spp.	200	400	500	300	300
<u>Notholca</u> <u>acuminata</u>					
<u>Notholca</u> <u>squamula</u>	200	100	100		200
ARTHROPODA					
<u>Cladocera</u>					
<u>Alona</u> sp.		5	5		5
<u>Pleuroxus</u> <u>aduncus</u>					
<u>Copepoda</u>				200	500
Nauplii				15	10
Cyclopoid copepodites	500	200	200		
<u>Bryocamptus</u> <u>hiemalis</u>	30	15	15		
<u>Eucyclops</u> <u>agilis</u>	5	10	10		10
<u>Ostracoda</u>					
Ostracoda (unidentified)	5	5		15	5

Table 3-8-130. Continued.

Below Confluence with Yellow Creek		Station
		<u>35</u>
PROTOZOA		
<u>Centropyxis</u> spp.		3600
<u>ciliates</u> (misc.)		
<u>Diffugia</u> spp.		100
<u>Epistylis</u> spp.		300
<u>Vorticella</u> spp.		
ROTIFERA		
<u>bdelloidea</u> (unidentified)		
<u>Cephalodella</u> spp.		
<u>Colurella</u> <u>adriatica</u>		
<u>Lepadella</u> <u>patella</u>		100
<u>monogononts</u> (unidentified)		4700
<u>Monostyla</u> spp.		300
<u>Notholca</u> <u>acuminata</u>		
<u>Notholca</u> <u>squamula</u>		
ARTHROPODA		
Cladocera		
<u>Alona</u> sp.		5
<u>Pleuroxus</u> <u>aduncus</u>		220
Copepoda		
Nauplii		
Cyclopoid copepodites		100
<u>Bryocamptus</u> <u>hiemalis</u>		
<u>Eucyclops</u> <u>agilis</u>		30
Ostracoda		
Ostracoda (unidentified)		5

Table 3-8-131. Mean densities of the major zooplankton taxa observed at the White River Stations during RBOSP Aquatic Baseline Studies, August - September 1975. (Data are expressed as organisms/m³ and are the means of duplicate samples.)

	Above Confluence with Yellow Creek		Station		
	<u>23</u>	<u>24</u>	<u>25</u>	<u>26</u>	<u>27</u>
PROTOZOA					
<u>Centropyxis</u> spp.	20600	11200	12700	11000	18200
<u>ciliates</u> (misc.)	100	700	600	300	400
<u>Diffugia</u> spp.	200	300	500	100	200
<u>Epistylis</u> spp.	1400	10000	2000	300	1100
<u>Vorticella</u> spp.			100	100	
ROTIFERA					
<u>bdelloidea</u> (unidentified)	200	100	200	500	200
<u>Cephalodella</u> spp.	300	200	400	300	300
<u>Colurella</u> <u>adriatica</u>	900	300	600	100	
<u>Lepadella</u> <u>patella</u>	200	100	400	500	300
<u>monogononts</u> (unidentified)	2100	3800	2300	2300	3300
<u>Monostyla</u> spp.	500	100	200	900	600
<u>Notholca</u> <u>acuminata</u>					
<u>Notholca</u> <u>squamula</u>					
ARTHROPODA					
Cladocera					
<u>Alona</u> sp.					5
<u>Pleuroxus</u> <u>aduncus</u>					
Copepoda					
Nauplii	700		100	200	200
Cyclopoid copepodites					
<u>Bryocamptus</u> <u>hiemalis</u>					
<u>Eucyclops</u> <u>agilis</u>	5		10		
Ostracoda					
Ostracoda (unidentified)				5	

Table 3-8-131. Continued.

At Confluence with Yellow Creek	Station	
	<u>28</u>	<u>29</u>
PROTOZOA		
<u>Centropyxis</u> spp.	5300	17800
<u>ciliates</u> (misc.)	900	500
<u>Diffugia</u> spp.	400	500
<u>Epistylis</u> spp.	300	3000
<u>Vorticella</u> spp.	100	300
ROTIFERA		
<u>bdelloidea</u> (unidentified)		100
<u>Cephalodella</u> spp.	200	600
<u>Colurella</u> <u>adriatica</u>		100
<u>Lepadella</u> <u>patella</u>	400	400
<u>monogononts</u> (unidentified)	2100	3000
<u>Monostyla</u> spp.	300	
<u>Notholca</u> <u>acuminata</u>		
<u>Notholca</u> <u>squamula</u>		
ARTHROPODA		
Cladocera		
<u>Alona</u> sp.		
<u>Pleuroxus</u> <u>aduncus</u>		
Copepoda		
Nauplii	100	
Cyclopoid copepodites		
<u>Bryocamptus</u> <u>hiemalis</u>		
<u>Eucyclops</u> <u>agilis</u>		
Ostracoda		
Ostracoda (unidentified)		

Table 3-8-131. Continued.

	Below Confluence with Yellow Creek		Station		
	30	31	32	33	34
PROTOZOA					
<u>Centropyxis</u> spp.	17900	16800	12200	15500	19400
<u>ciliates</u> (misc.)	600	100	300		400
<u>Diffugia</u> spp.	700	300	600	300	100
<u>Epistylis</u> spp.	4000	1200	1500	100	1000
<u>Vorticella</u> spp.		200	200		100
ROTIFERA					
<u>bdelloidea</u> (unidentified)			100	200	
<u>Cephalodella</u> spp.	300	400	300	200	300
<u>Colurella adriatica</u>		200	100		
<u>Lepadella patella</u>	300	300	300	300	200
<u>monogononts</u> (unidentified)	2000	1800	3000	2600	3600
<u>Monostyla</u> spp.	200	400	100	800	500
<u>Notholca acuminata</u>					
<u>Notholca squamula</u>					
ARTHROPODA					
Cladocera					
<u>Alona</u> sp.					
<u>Pleuroxus aduncus</u>	15				
Copepoda					
Nauplii	200			100	
Cyclopoid copepodites					
<u>Bryocamptus hiemalis</u>					
<u>Eucyclops agilis</u>	5	10			
Ostracoda					
Ostracoda (unidentified)					

Table 3-8-131. Continued.

Below Confluence with Yellow Creek		Station
		<u>35</u>
PROTOZOA		
<u>Centropyxis</u> spp.		17400
<u>ciliates</u> (misc.)		100
<u>Diffugia</u> spp.		200
<u>Epistylis</u> spp.		1700
<u>Vorticella</u> spp.		
ROTIFERA		
<u>bdelloidea</u> (unidentified)		
<u>Cephalodella</u> spp.		900
<u>Colurella</u> <u>adriatica</u>		100
<u>Lepadella</u> <u>patella</u>		200
<u>monogononts</u> (unidentified)		3500
<u>Monostyla</u> spp.		300
<u>Notholca</u> <u>acuminata</u>		
<u>Notholca</u> <u>squamula</u>		
ARTHROPODA		
Cladocera		
<u>Alona</u> sp.		
<u>Pleuroxus</u> <u>aduncus</u>		
Copepoda		
<u>Nauplii</u>		100
<u>Cyclopoid</u> copepodites		
<u>Bryocamptus</u> <u>hiemalis</u>		
<u>Eucyclops</u> <u>agilis</u>		
Ostracoda		
Ostracoda (unidentified)		

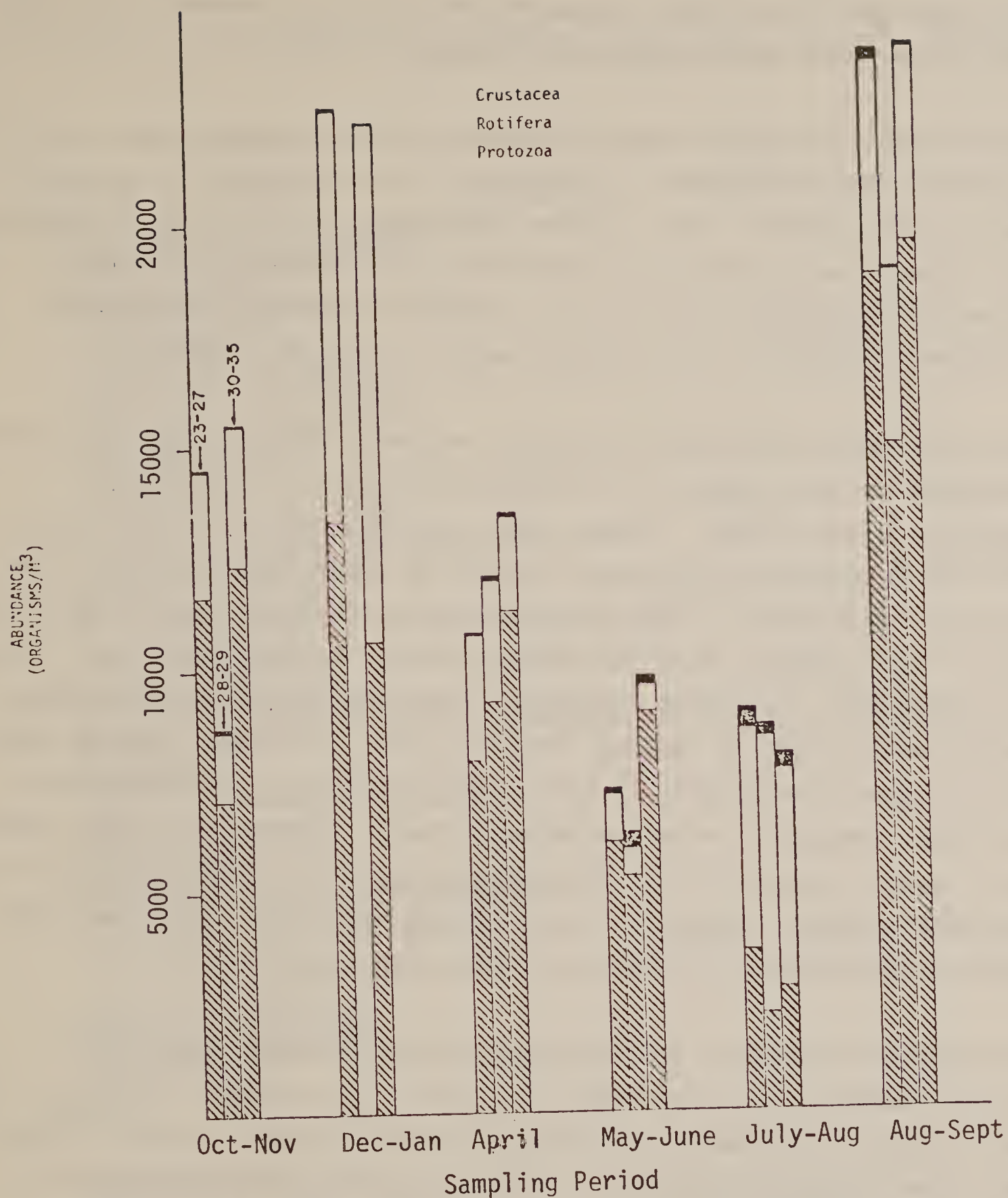


Figure 3-8-25. Zooplankton densities for Station groups (23-27; 28-29; 30-35) in the White River during RBOSP Aquatic Baseline Studies from October - November 1974 to August - September 1975. (Samples could not be collected at Station 28-29 during December 1974 - January 1975.)

23,000 above and below the confluence in August. As many as 36 Protozoa, 29 Rotifera and 19 Crustacea taxa were identified with several more unidentified forms observed (Tables 3-8-132 through 3-8-134).

Protozoan densities were lowest in May-June and July-August; peak densities occurred in August-September. Centropyxis spp. and Vorticella spp. were generally the dominant taxa. In June, when densities were low, Centropyxis spp. in most cases composed well over 90% of all Protozoa. In August-September, Centropyxis spp. were very abundant, with densities between 11,000 and 20,600/m³ at all stations except Station 28 (5,300/m³).

The rotifer fauna consisted of bdelloid rotifers, Notholca spp., and several monogonont rotifers typical of a littoral habitat, e.g., Monostyla, Lepadella (Donner, 1956). Highest densities occurred in December-January with mean densities of 9,125 and 11,617/m³ at upper and lower White River stations, respectively. Contracted monogonont rotifers (often at densities greater than 4,000/m³) were the dominant forms. Several other taxa, including Cephalodella, Colurella, Lepadella, Monostyla, bdelloids and Notholca species were present in low densities (less than 1,000/m³). Rotifer densities decreased considerably by April; Notholca squamula, bdelloids, and contracted monogononts were the dominant forms. Rotifers were least abundant in June, concurrent with the appearance of several summer taxa such as Euchlanis dilatata, Lecane sp. and Trichotria pocillum. Contracted monogononts dominated the rotifer fauna during the summer.

Crustacea were sparse at all stations; densities ranged from 33/m³ in October-November (lower stations) to 423/m³ in July (upper stations). Immature copepods dominated the Crustacea fauna throughout the year, with a few mature Eucyclops agilis and ostracods occurring sporadically in all months. In the spring and summer, several Cladocera, e.g., Chydorus sphaericus, Pleuroxus aduncus, Alona spp. occurred in low numbers at several stations.

Table 3-8-132. Zooplankton taxa observed at White River Stations above confluence with Yellow Creek, October - November 1974 through August - September 1975.

PROTOZOA

Actinosphaerium eichhorni
Arcella vulgaris
Astramoeba radiosa
Campanella sp.
Centropyxis aculeata
Centropyxis arcelloides
Centropyxis constricta
Centropyxis sp.
Chilodonella sp.
ciliates (unidentified)
Cucurbitella mespiliformis
Cyphoderia ampulla
Diffugia acuminata
Diffugia gramen
Diffugia lebes
Diffugia lobostoma
Diffugia oblonga
Diffugia sp.
Dileptus sp.
Epistylis sp.
Euglypha compressa
Heleopera sp.
Paramecium multimicronucleatum
Paramecium sp.
Platyophrya sp.
rhizopods (unidentified)
Vorticella campanula
Vorticella microstoma
Vorticella sp.

ROTIFERA

Asplanchna sp.
bdelloidea (unidentified)
Brachionus quadridentatus
Cephalodella forficula
Cephalodella gibba
Cephalodella spp.
Colurella adriatica
Colurella sp.

Table 3-8-132. Continued.

Euchlanis dilatata
Filinia longiseta
Keratella quadrata
Lecane tuna
Lecane sp.
Lepadella patella
Lepadella sp.
monogonont (unidentified)
Monostyla bulla
Monostyla closterocerca
Monostyla tunaris
Monostyla sp.
Notholca acuminata
Notholca foliacea
Notholca squamula
Platylas quadricornis
Polyarthra dolichoptera
Polyarthra sp.
Proales sp.
Synchaeta sp.
Trichotria pocillum

TARDIGRADA

ARTHROPODA

Crustacea

Cladocera

Alona circumfimbriata
Alona sp.
Bosmina longirostris
Ceriodaphnia sp.
Chydorus sphaericus
Daphnia pulex
Kurzia latissima
Macrothrix laticornis
Moina sp.
Pleuroxus aduncus
Simocephalus vetulus

Copepoda

Nauplii

Calanoid copepodites
Cyclopoid copepodites
Harpacticoid copepodites
Bryocamptus hiemalis
Cyclops vernalis
Diaptomus sp.

Table 3-8-132. Continued.

ARTHROPODA (cont.)

Eucyclops agilis

Harpacticoida spp. (unidentified)

Paracyclops fimbriata poppei

Ostracoda

Ostracoda (unidentified)

Table 3-8-133. Zooplankton taxa observed at White River Stations at confluence with Yellow Creek, October - November 1974 through August - September 1975.

PROTOZOA

Amoeba sp.
Arcella vulgaris
Centropyxis aculeata
Centropyxis arcelloides
Centropyxis constricta
Chilodonella sp.
ciliates (unidentified)
Cyphoderia ampulla
Diffugia acuminata
Diffugia lebes
Diffugia oblonga
Diffugia sp.
Epistylis sp.
Nebela flabellulum
Paramecium sp.
Rhabdostyla sp.
rhizopods (unidentified)
Trachelius ovum
Vorticella sp.

ROTIFERA

bdelloidea (unidentified)
Cephalodella gibba
Cephalodella sp.
Colurella adriatica
Euchlanis dilatata
Keratella quadrata
Lecane luna
Lepadella patella
Lepadella sp.
monogonont (unidentified)
Monostyla bullae
Monostyla closterocerca
Monostyla lunaris
Monostyla sp.
Mytilina ventralis
Notholca acuminata
Notholca squamula
Platylabus quadricornis
Polyarthra sp.
Trichocerca cylindrica
Trichotria pocillum

Table 3-8-133. Continued.

TARDIGRADA

ARTHROPODA

Crustacea

Cladocera

Alona circumfimbriata

Alona sp.

Ceriodaphnia sp.

Moina rectirostris

Pleuroxus aduncus

Simocephalus vetulus

Copepoda

Nauplii

Cyclopoid copepodites

Eucyclops agilis

Harpacticoida spp. (unidentified)

Paracyclops fimbriatus poppei

Ostracoda

Ostracoda (unidentified)

Table 3-8-134. Zooplankton taxa observed at White River Stations below confluence with Yellow Creek, October - November 1974 through August - September 1975.

PROTOZOA

Arcella polypora
Arcella vulgaris
Centropyxis aculeata
Centropyxis arcelloides
Centropyxis constricta
Chilodonella sp.
ciliates (unidentified)
Codonella cratera
Cyphoderia amputa
Didinium nasutum
Didinium sp.
Diffugia acuminata
Diffugia lanceolata
Diffugia lebes
Diffugia lobostoma
Diffugia oblonga
Diffugia tuberculata
Diffugia urceolata
Diffugia sp.
Dileptus sp.
Epistylis sp.
Euglypha compressa
Euglypha laevis
Opercularia sp.
Paramecium aurelia
Paramecium sp.
rhizopods (unidentified)
Tintinnidium sp.
Vorticella convallaria
Vorticella sp.

ROTIFERA

Asplanchna sp.
bdelloidea (unidentified)
Brachionus quadridentatus
Cephalodella forficula
Cephalodella gibba
Cephalodella sp.
Colurella adriatica
Colurella obtusa
Colurella sp.

Table 3-8-134. Continued.

ROTIFERA (Cont.)

Euchlanis dilatata
Gastropus sp.
Keratella cochlearis
Keratella quadrata
Keratella sp.
Lecane flexilis
Lecane Tuna
Lecane sp.
Lepadella patella
Lepadella sp.
monogonont (unidentified)
Monostyla bulla
Monostyla closteroerca
Monostyla Tunaris
Monostyla sp.
Mytilina ventralis
Notholca acuminata
Notholca foliacea
Notholca squamula
Platyias quadricornis
Polyarthra sp.
Proales sp.
Synchaeta sp.
Trichocerca cylindrica
Trichocerca sp.
Trichotria pocillum

TARDIGRADA

ARTHROPODA

Crustacea

Cladocera

Alona circumfimbriata
Alona guttata
Alona sp.
Alonella excisa
Bosmina longirostris
Ceriodaphnia quadrangula
Ceriodaphnia sp.
Chydorus sphaericus
Moina sp.
Pleuroxus aduncus
Simocephalus vetulus

Copepoda

Table 3-8-134. Continued.

ARTHROPODA (cont.)

Nauplii
Cyclopoid copepodites
Bryocamptus zschokkei
Cyclops vernalis
Eucyclops agilis
Harpacticoida spp. (unidentified)
Ostracoda
Ostracoda (unidentified)

5. Discussion - Two habitat types were sampled at the headwaters and on and near the tract. The habitat sampled at Stations 1-4, 7-9, and 13 is that of a cold spring-brook which has very near constant temperatures throughout the year. The bottom substrates consist of gravel, sand and shale chunks often covered by periphyton. Macrophytes were absent or rare, possibly explaining the low numbers of littoral Rotifera and Cladocera. The high densities of Centropyxis spp. at Stations 7, 8, 9 and 13 can be correlated with spring run-off due to snow-melt, as these stations were very turbid during sampling. The dominant Crustacea observed included the cyclopoid Eucyclops agilis and the harpacticoid Bryocamptus hiemalis. Eucyclops agilis is a cosmopolitan species common in a wide variety of habitats, including cold springs (Rylov, 1948). No information is available as to the habitat requirements of Bryocamptus hiemalis, however, a form of this species, B. hiemalis brevifurca, has been collected from a lake in New York and several habitats in North Carolina, including a brook, a marsh and a small spring filled with leaves and debris (Coker, 1934). Information describing the tolerances to such factors as salinity and alkalinity is not available for this particular species; however, Remane and Schlieper (1971) list freshwater Harpacticoida as often intolerant of saline waters. Temperature may possibly be more important in controlling the distribution of Bryocamptus hiemalis, since several specimens were collected at the lower Yellow Creek stations (20-22) in the winter sampling but none were observed in other months. Bryocamptus hiemalis, including ovigerous females, was abundant throughout the year at the spring-brook stations.

Stations 6, 12, 15, 17-18, which were dry much of the year but which flowed at least once, were characterized by a fauna similar to that at stations on the spring-brooks from which they received their flow.

Stations 5 and 14 were representative of a littoral pond habitat. Station 5 was located at the outlet of a marshy, pond-like seepage area. This seepage area (the source of flow at Station 5) extended as far as 0.5 mi (800 m) above the station. The whole area was relatively flat and covered

by sedges, cress and other vegetation. As a result, the zooplankton at Station 5 was comparable to that at the lower Yellow Creek Stations (19-22). Species composition and factors controlling the spatial and temporal distribution of several of the organisms at Station 5 will therefore be included in the discussion of Stations 19-22.

Macrocyclops albidus, a cosmopolitan cyclopoid, occurred only at Station 5. This species inhabits the same wide variety of habitats as does Eucyclops agilis. Rylov (1948) describes M. albidus as common in habitats similar to the marsh above Station 5, as tolerant of strongly alkaline waters, and as markedly euryhaline. Because only six individuals were found and then only during July-August, its rarity may explain the absence from samples taken at the lower stations.

Station 14 is a pond in Corral Gulch which is utilized as a source of water for settling dust on the adjoining dirt road. During the summer the pond developed thick mats of Zannichellia palustris which covered the entire pond by August. These mats had also been present in October-November of the previous year. A seepage approximately 0.26 mi (400 m) upstream of the pond provided a constant flow through the pond. The dominant taxa consisted of littoral forms of rotifers and crustaceans. The dominance of Ceriodaphnia quadrangula at Station 14, as compared with its relative subordination to Alona and Pleuroxus at similar habitats at Station 5 and in the lower section of Yellow Creek, may be correlated with the lower specific conductivities at Station 14, but more likely to the presence of Zannichellia palustris or horned pond weed at Station 14. Quade (1969), during a study of the affinities of Cladocera to aquatic plants, observed that the highest abundance of Ceriodaphnia was associated with Najas, a fine-leaved submersed pond weed similar in structure to Zannichellia (Fassett, 1957). The high diversity and densities of littoral rotifers, such as bdelloids, Monostyla, Lepadella, Euchlanis and other monogononts, are significantly related to the rich growth of the macrophyte as the abundances of littoral rotifers are governed by the amount of available substrate (Pennak, 1953).

The lower section of Yellow Creek can be described as a slightly brackish (Pennak, 1974) littoral habitat; alkalinities and conductivities are considerably higher than at the stations nearer the tract. The lower stations (20-22) were very similar to each other; zooplankton samples at these stations were taken from basically the same water mass. The stations, all within an 0.25 mi (400 m) section of Yellow Creek, were almost always sampled on the same day but usually at least one hour apart. Differences in species composition and densities among these stations may be in consequence of such changing physical variables as water temperature, DO and conductivity as these characteristics were observed to vary diurnally.

The accidental presence of benthic Rhizopoda species in the plankton is well illustrated at the lower stations in April. After samples were taken at Station 22, a flock of sheep crossed the creek just upstream of Station 20, significantly increasing the turbidity in the stream. Samples taken shortly thereafter at Stations 21 and 20 showed considerably higher densities of rhizopods than were observed at Station 22.

A similar occurrence can explain the relatively high density of Centropyxis spp. at Station 20 in July. The pump used in collection of zooplankton samples developed mechanical difficulty, necessitating that a dipping method be used to collect the sample volume. Dipping apparently disturbed the substrate sufficiently to introduce a large number of Centropyxis spp. into the plankton, resulting in relatively high densities of Centropyxis spp. in the sample.

The great abundance of Chara kieneri at Station 19 and its absence from the lower stations, the wide diurnal variation of temperatures at the lower stations, the consistently cooler temperatures at Station 19, and the pond conditions at Station 19 were contributing factors to the differences in species composition and abundance between Station 19 and the lower stations. However, very high alkalinities and high conductivities were characteristic of both areas.

The rotifer fauna at Yellow Creek stations was identical to that which occurred throughout the study area. This faunal list consists almost entirely of cosmopolitan species characteristic of alkaline waters (Myers, 1931, Ahlstrom, 1932, Edmondson, 1936). The species present, e.g., Notholca acuminata, N. squamula and Colurella adriatica are also very tolerant of brackish water and even sea water (Remane and Schlieper, 1971).

Temperature is probably the most important factor controlling the abundance of Notholca species in the four Yellow Creek stations. Notholca has been described as a cold stenotherm intolerant of temperatures of 25°C or higher (Ruttner-Kolisko, 1974), although Carlin (1943) found that, in brackish water, it apparently occurs in summer at high temperatures. The pond at Station 19 showed little of the daily temperature fluctuation that was observed at the lower stations, and thus presented a more suitable habitat for the Notholca species. However, an increase in temperature from 14°C to 22°C (in June and July, respectively) apparently produced a great decrease in the Notholca populations at this station.

Several differences in the distribution of Crustacea occurred at the Yellow Creek stations. The abundance of Eucyclops agilis is not unexpected, as this cyclopoid is found in a wide variety of habitats. The presence of mature forms throughout the year, its adaptability to widely changing temperatures, its euryhaline characteristics (Rylov, 1948) account for its abundance throughout the year in Yellow Creek. The appearance of Eucyclops speratus, Cyclops vernalis and Paracyclops fimbriatus poppie are perhaps adventitious, as the first two are perhaps intolerant of brackish waters and the third is usually not present in waters of high alkalinity (Rylov, 1948). However, Remane and Schlieper (1971) describe E. speratus as tolerant of low salinities.

Although Cladocera, in general, are restricted to freshwater areas of less than 1% salinity, such species as Ceriodaphnia quadrangula, Chydorus sphaericus and Simocephalus vetulus have been found to occur in salinities up to 4-5% (Remane and Schlieper, 1971). Alona rectangula, a species

closely related to Alona circumfimbriata, has been found in salinities of 13.8% (Smirnov, 1971). In addition one species of Pleuroxus, i.e., P. trigonellus occurs in salinities up to 2.1% (Smirnov, 1971).

The Cladocera observed are typically summer, littoral species, thus accounting for their abundance in August-September. The differences in relative abundance among the four Yellow Creek stations may be related to vegetation type and density. The higher relative abundance of Pleuroxus aduncus at lower Yellow Creek stations may be correlated to the abundance of filamentous algae in the stream in late summer (Smirnov, 1971). The dense mats of Chara at Station 19 may account for the high population density of Alona circumfimbriata, as affinities to Chara have been documented for Alona costata and Alona guttata (Quade, 1969), two species of similar size as A. circumfimbriata.

Most studies of the zooplankton of rivers have concluded that the fauna present is planktonic, and has been contributed by lakes, ponds and quiet areas along the drainage system. Such is not the case with the White River, as the majority of the organisms found are not planktonic but are benthic or littoral. As a result, the plankton densities observed in the White River are generally lower than those reported in other studies of larger, slower-moving streams (Kofoid, 1908, Eddy, 1932).

The dominance of the Rhizopoda, i.e., Centropyxis spp., in White River samples is of interest. One study (Reinhard, 1931) showed these taxa to be almost non-existent in river plankton. The Rhizopoda are considered as benthic organisms and their presence in river plankton is largely a result of disturbances by the current (Kofoid, 1908; Pennak, 1943). This would explain the consistency of densities from October to April when flow conditions were similar during this period. The low densities in June, during the flood stage of the river, suggests that although the bottom sediments were disturbed to a greater extent than normal, the larger number of rhizopods introduced into the water column were diluted or had already been flushed away.

Increased rhizopod densities in September are significant as this phenomena has been documented previously (Kofoed, 1908). Hutchinson (1967) and Hynes (1970) consider these marked increases of rhizopods in the plankton as a physiological adaptation to anaerobic conditions at the substrate interface.

The rotifer fauna differed considerably from what is normally found in rivers. Planktonic forms, i.e., Brachionus, Keratella cochlearis, Filinia longiseta, Polyarthra, Synchaeta and Trichocerca, were rare or non-existent in the White River, whereas they are the dominant rotifers in the rivers previously studied (Eddy, 1932; 1934; Pennak, 1943; Williams, 1966). Hynes (1970) includes Notholca and Euchlanis in this list as common members of the river plankton. Of these supposedly dominant river taxa, only Notholca and Euchlanis were of numerical importance in the White River.

The dominant taxa at the White River were littoral forms such as bdelloids, Cephalodella, Monostyla, Colurella, Lepadella, contracted monogononts, etc. This fauna is usually associated with a substrate on which they live and feed, is characteristic of ponds and marshes and is suggestive of the "erosional assemblage" of streams described by Cummins (1972). However, the species in the river are the same as those occurring in the Yellow Creek drainage system, indicating possible sources of recruitment, i.e., many small streams and irrigation canals which drain into the river. The low numbers in June (normally the peak period for rotifer densities) can be correlated with the flood conditions of May and June and the intolerance of rotifers to turbulence and silty conditions (Williams, 1966).

The paucity of ponds and lakes in the White River drainage system near the study area and with the lack of quiet backwaters and pools in the river itself explain the low numbers of planktonic rotifers and limnetic Crustacea in the White River. The few limnetic copepods which did occur (calanoid copepodites and Diaptomus species) were badly mangled, indicative of the effect of the river's turbulence. This effect has been reported by Galtsoff (1924), who found that one rapids area on the upper Missouri River

destroyed 60% of the river's plankton. The occurrence of Cladocera such as Alona, Pleuroxus and Chydorus in the White River are as expected, because forms such as these with compact, rounded bodies are more prone to survive the turbulence of the river. However, as with rotifers, the crustacean fauna of the river is identical to that of the Yellow Creek drainage system, suggesting that the river zooplankton may be the product of tributaries like Yellow Creek.

A comparison of the zooplankton above, below and within the vicinity of the Yellow Creek confluence suggests few or no differences attributable to Yellow Creek. Species composition and total densities are very similar in all three areas, although in October-November and August-September, the protozoan densities near Yellow Creek (Stations 28 and 29) were somewhat lower than either above or below the confluence. As this was mainly the result of high Centropyxis spp. densities, these protozoans may have settled out of the plankton in the relatively quiet backwater at Station 27, just above the confluence. No other major differences in zooplankton species composition or densities among the areas were observed.

In summary, the zooplankton fauna occurring in the study area consisted almost entirely of species commonly associated with a substrate, the nature of the substrate being either macrophytes or stones, gravel, detritus, etc. This fauna included rhizopods, protozoans, littoral rotifers, chydorid cladocerans, harpacticoid copepods (all herbivores), and cyclopoid copepods (predominantly carnivores). The most important factor controlling the distribution of these taxa (directly or indirectly) was temperature. Peak densities and number of species for rotifers and cladocerans occurred during the summer months, associated with warmer temperature and increased periphytic growth. Maximum densities of the predaceous cyclopoids can be related to the increased abundance of their food; i.e., the rotifers and cladocerans. Only the harpacticoid copepod Bryocamptus hiemalis and the rotifer Notholca were restricted to either the winter months or the cooler water of the spring brooks. Zooplankton densities were generally lowest in the White River where there was a paucity of potential sources of recruitment such as lakes, ponds, and quiet back water areas.

C. Periphyton

1. Objectives - Periphyton studies were conducted to determine the species composition and standing crops of the periphyton communities to further aid in the characterization of the aquatic habitats on and near Tract C-a.

2. Methods - Six samples were collected at each station from natural substrates. Three of these were used to estimate abundance and three were used to determine biomass. Periphyton samples were collected from rocks that were relatively flat, which faced the surface of the water, and which were positioned at mid-depth in riffles. Rocks were carefully removed from the streams and periphyton was removed from a 50-cm^2 (7.7 in^2) area with a toothbrush and knife. Samples were stored in 4-oz jars containing 5% formalin until processing.

In the laboratory, preserved periphyton samples were diluted to a constant volume and an aliquot was removed, centrifuged, and washed with distilled water. The samples were then dehydrated and stained in the centrifuge, using successive spinnings and decantings. The same series of stains and alcohol dilutions were used for the periphyton as was described for the phytoplankton. A number of drops of the final xylene-periphyton suspension were placed on a microscope slide with Hyrax, heated gently, and covered with an ultra-thin coverglass. The final mounts are retained in the permanent voucher collection.

Periphyton was counted from one or two randomly chosen transects at 1000x (oil immersion). All organisms appearing in these transects were identified and counted. The whole slide was surveyed at 100x to identify and enumerate the larger rare species. Counts are expressed as cells per unit area. Filamentous taxa are expressed as 50 micron-length units. These data were used to compute relative abundance and species diversity.

Biomass determinations were made on samples which were dried to a constant weight at 105°C and weighed. The samples were then ashed at 500°C

(Vollenweider, 1969) and the ash-free dry weight was calculated as an estimate of the organic weight or biomass of the periphyton.

During the May - June, July - August, and August - September 1975 sampling period an additional set of three replicate 50 cm² (7.7 in²) periphyton samples were collected for chlorophyll a determinations. Each replicate of the water-periphyton suspensions was filtered through a 0.65 micron pore size Millipore filter along with 2.5 ml of concentrated MgCO₃ solution (and then frozen and stored in the dark until analysis. In the laboratory, the chlorophyll a was extracted in 90% aqueous acetone after the samples had been macerated with a tissue grinder. Chlorophyll a was then computed according to the trichromatic spectrophotometric techniques of Lorenzen (1967).

Also during the May - June, July - August, and August - September 1975 sampling periods, three replicate samples, each representing a 38 cm² (5.9 in²) area, were taken from artificial substrates (glass slides) at six stations (20, 21, 23, 27, 29, and 35). From these artificial substrates, data for cell density, biomass, and chlorophyll a were determined.

3. Literature Review - Periphyton, the benthic algal community, is the most important source of fixed energy in many streams (Hynes, 1970). There are two major types of periphytic algae; unattached and attached. Unattached algae, such as some members of the genera Navicula, Nitzschia, Surirella, and Pleurosigma, live on or in the substrate, but cannot move or are only weakly mobile. Attached algae, such as members of the genera Cymbella, Achnanthes, Cocconeis, Gomphonema and numerous filamentous green algae, are found attached to the substrate by secreted gelatinous stalks, filaments, or specialized basal attachment cells. Unattached algae can be more easily washed away in spates, while attached algae can maintain their position in higher flows. Thus, attached algae are often dominant in winter and spring during periods of high flow, while unattached algae may be more common in summer during periods of low flow.

Periphyton communities of flowing waters have been described by many authors; notably Butcher, 1932, Round, 1964, Blum, 1957, Dillard, 1969 and others.

In a majority of studies diatoms predominated, although filamentous green and blue-green algae were frequently important. There is usually little distinction between the attached and planktonic algal of flowing waters as the latter are largely derived from periphyton (Butcher, 1932, Lund and Talling, 1957, Cushing, 1964). Periphyton may include algae attached to, or on rocks, mud, plants or any other underwater surface.

The importance of the periphyton community was not recognized until the 1930's when Butcher (1932) investigated the subject. Since then, numerous studies from diverse habitats have been reported. Studies of periphyton communities of flowing waters have been extensive, although few investigations have been done on stream periphyton of semi-arid lands such as those on or near Tract C-a. The ecology of periphyton communities of Tract C-a and adjacent areas is not affected by major seasonal changes in allochthonous detrital input such as experienced by streams of forested areas. Similarly, there is little change in light availability due to vegetation changes throughout the seasons, modifying stream cover. Thus, chemical-geological factors, and seasonal light and temperature changes may be assumed to have the most important influences on periphyton communities.

Literature dealing with periphyton of streams of similar arid lands is rare. One extreme example was the study of Brown (1965) which described algal taxa from the various bodies of water in central Death Valley desert. In most cases data are not comparable to RBOSP studies due to high temperatures in Death Valley.

Other stream studies that may be relevant include the study by Johnson et al (1975) study of Oak Creek, Arizona; Clark's (1958) study of the Logan River, Utah, phytoplankton; Brinley's (1950) study of Colorado stream phytoplankton; and Gumtow's (1955) study of periphyton of the Gallatin River, Montana. While all of the above stream studies are in western states, there are few similarities between the creeks or the country they drain and the Yellow Creek watershed. Consequently, the taxa were not very similar.

Periphytic algae of hardwater springs and streams has been studied by Butcher (1946) and Round (1957). Round (1957) noted a very low diversity of species on epilithic samples from calcareous streams of chalk hills in Buckinghamshire. Gomphonema intricatum var. pumilum completely dominated the communities although there were also small numbers of Achnanthes lanceolata. Butcher (1946) studied calcareous streams and found the abundant species to be Fragilaria intermedia, F. leptostauron, Cocconeis placentula, Achnanthes minutissima, A. linearis, A. lanceolata, Navicula cryptocephala, N. veridula, Cymbella ventricosus, Gomphonema parvulum, G. constructum, G. olivaceum, Nitzschia palea and N. acicularis. Foged (1947-1949, cited in Round, 1957) reported similar taxa from alkaline Danish streams; and he also reported Thalassiosira fluviatilis, a planktonic diatom found in the present study.

There has been one superficial study of the algae of the Piceance and Yellow Creeks, in which Pennak (1974) studied the attached communities on rocks. The community he terms "lithophyton" is the subject of the present report (periphyton). Pennak found lithophyton to be almost absent in Yellow Creek from June to October, 1973 while exceptionally large standing crops were seen in Piceance Creek, (his data were based on organic weights determined from loss on ignition). On one date (July 18) the author did see a heavy growth of filamentous algae. He postulates that the high salt content of Yellow Creek inhibits algal growth.

Pennak (1974) also studied the "lithophyton" of the White River at two locations near the confluence with Piceance Creek. The lithophyton was characterized at 2% algae and 85% detritus at one station and 25% diatoms and 60% "algae" at the other. The standing crops were considered high although lack of standardized methods prohibits comparisons with the literature.

4. Data Summary

a. Headwaters - Densities of major periphyton taxa (15 most abundant by station group) from collections at Headwater stations from October 1974 to September 1975 are summarized in Tables 3-8-135 through 3-8-140. Algal

Table 3-8-135. Mean densities of the major algal taxa observed in the periphyton at the Headwater Stations during RBOSP Aquatic Baseline Studies, October - November 1974. (Data are expressed as cells/mm² except that data for filamentous forms are expressed as the number of 50 μ units.)

	Station				
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
CYANOPHYTA					
<u>Lyngbya</u> spp.					
<u>Oscillatoria</u> spp.					
<u>Plectonema</u> spp.		1321			
<u>Calothrix</u> spp.					
CHLOROPHYTA					
<u>Ulothrix</u> spp.					
CHRYSTOPHYTA					
<u>Cyclotella meneghiniana</u>					
<u>Diatoma vulgare</u>					
<u>Meridion circulare</u>					
<u>Fragilaria vaucheriae</u>					383
<u>Synedra amphicephala</u>		434			1823
<u>Synedra ulna</u>	1	83		146	90
<u>Achnanthes lanceolata</u>		2	20	250	11
<u>Achnanthes minutissima</u>	145	322	385	1760	4433
<u>Pleurosigma delicatulum</u>					259
<u>Navicula cryptocephala</u>	2	20	32	277	315
<u>Navicula pelliculosa</u>		2	29	140	
<u>Navicula salinarum</u> var. <u>intermedia</u>					

Table 3-8-135. Continued

	Station				
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
<u>Navicula tripunctata</u>					
<u>Navicula sp. 1</u>			14	59	45
<u>Cymbella affinis</u>	1	39	5	41	56
<u>Cymbella pusilla</u>					
<u>Gomphonema angustatum</u>					
<u>Gomphonema intricatum</u>	1		5	27	101
<u>Gomphonema olivaceum</u>					
<u>Gomphonema ventricosum</u>					
<u>Epithemia sorex</u>					
<u>Rhopalodia gibberula</u>					
<u>Nitzschia dissipata</u>					
<u>Nitzschia frustulum</u>	1	27	63	2	383
<u>Nitzschia linearis</u>	1	27	25	86	
<u>Nitzschia palea</u>		50	7	14	45

Table 3-8-136. Mean densities of the major algal taxa observed in the periphyton at the Headwater Stations during RBOSP Aquatic Baseline Studies, December 1974 - January 1975. (Data are expressed as cells/mm² except that data for filamentous forms are expressed as the number of 50 μ units.)

	Station	
	3	4
CYANOPHYTA		
<u>Lyngbya</u> spp.	90	
<u>Calothrix</u> spp.		
CHLOROPHYTA		
<u>Zygnema</u> spp.	68	
CHRYSTOPHYTA		
<u>Diatoma</u> <u>hiemale</u>	142	
<u>Diatoma</u> <u>vulgare</u>		
<u>Meridion</u> <u>circulare</u>		92
<u>Fragilaria</u> <u>vaucheriae</u>		
<u>Synedra</u> <u>amphicephala</u>		131
<u>Synedra</u> <u>ulna</u>	1	79
<u>Cocconeis</u> <u>pediculus</u>		
<u>Achnanthes</u> <u>lanceolata</u>	1850	241
<u>Achnanthes</u> <u>minutissima</u>	3780	17275
<u>Navicula</u> <u>arvensis</u>	77	36
<u>Navicula</u> <u>cryptocephala</u>	59	218
<u>Navicula</u> <u>minima</u>	63	5

¹ Stations 1, 2, and 5 were inaccessible, snow covered or frozen solid during sampling period.

Table 3-8-136. Continued.

	Station	
	<u>3</u>	<u>4</u>
CHRY SOPHYTA (Cont.)		
<u>Navicula pelliculosa</u>		
<u>Navicula salinarum</u> var. <u>intermedia</u>		
<u>Navicula tripunctata</u>		
<u>Navicula viridula</u>		
<u>Amphora ovalis</u>		
<u>Amphora ovalis</u> var. <u>pediculus</u>		
<u>Cymbella affinis</u>	128	137
<u>Gomphonema intricatum</u>	160	1325
<u>Gomphonema olivaceum</u>		
<u>Gomphonema ventricosum</u>		
<u>Epithemia sorex</u>		
<u>Nitzschia apiculata</u>		
<u>Nitzschia baccata</u>		
<u>Nitzschia denticula</u> '		
<u>Nitzschia dissipata</u>		
<u>Nitzschia frustulum</u>	1236	14
<u>Nitzschia linearis</u>	7	315
<u>Nitzschia palea</u>		
<u>Surirella ovata</u>		

Table 3-8-137. Mean densities of the major algal taxa observed in the periphyton at the Headwater Stations during RBOSP Aquatic Baseline Studies, April 1975. (Data are expressed as cells/mm² except that data for filamentous forms are expressed as the number of 50μ units.)

	Station				
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
CYANOPHYTA					
<u>Lyngbya</u> spp.					
<u>Plectonema</u> spp.					
<u>Calothrix</u> spp.					
CHLOROPHYTA					
<u>Ulothrix</u> spp.	124	28			
CHRYSTOPHYTA					
<u>Meridion</u> <u>circulare</u>	23				484
<u>Fragilaria</u> <u>vaucheriae</u>	25	106	66	33	488
<u>Synedra</u> <u>amphicephala</u>	23	50	16	1	199
<u>Achnanthes</u> <u>lanceolata</u>	12402	6717	2032	3485	3773
<u>Achnanthes</u> <u>minutissima</u>	229	16	18	35	96
<u>Navicula</u> <u>arvensis</u>	2	16	18	33	193
<u>Navicula</u> <u>cryptocephala</u>					
<u>Navicula</u> <u>pelliculosa</u>					
<u>Navicula</u> <u>salinarum</u> var. <u>intermedia</u>					
<u>Navicula</u> <u>tripunctata</u>					
<u>Navicula</u> <u>viridula</u>					
<u>Navicula</u> sp. 1	23		12	19	73
<u>Navicula</u> sp. 2					
<u>Amphora</u> <u>ovalis</u> var. <u>pediculus</u>					
<u>Cymbella</u> <u>affinis</u>	101	21	8		7

Table 3-8-137. Continued.

	Station				
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
CHRYSTOPHYTA (Cont.)					
<u>Cymbella ventricosa</u>					
<u>Gomphonema intricatum</u>	160	27	42	140	1571
<u>Gomphonema olivaceum</u>					
<u>Epithemia sorex</u>					
<u>Rhopalodia gibberula</u>					
<u>Nitzschia chasei</u>					
<u>Nitzschia denticula</u>	225	7	1	14	
<u>Nitzschia dissipata</u>					
<u>Nitzschia frustulum</u>		7	26	1	231
<u>Nitzschia linearis</u>	41		1	53	11
<u>Nitzschia palea</u>		41	11		137
<u>Surirella ovata</u>					573

Table 3-8-138. Mean densities of the major algal taxa observed in the periphyton at the Headwater Stations during RBOSP Aquatic Baseline Studies, May - June 1975. (Data are expressed as cells/mm² except that data for filamentous forms are expressed as the number of 50 μ units.)

	Station				
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
CYANOPHYTA					
<u>Lyngbya</u> spp.					
<u>Schizothrix</u> spp.					
<u>Plectonema</u> spp.					
<u>Calothrix</u> spp.					
CHLOROPHYTA					
<u>Cladophora</u> spp.		97		23	
CHRYSTOPHYTA					
<u>Bicoeca lacustris</u>	4334				
<u>Cyclotella meneghiniana</u>					
<u>Fragilaria vaucheriae</u>					
<u>Synedra amphicephala</u>		26	4		36
<u>Synedra pulchella</u>					
<u>Synedra ulna</u>					
<u>Achnanthes lanceolata</u>		11	85	28	9
<u>Achnanthes minutissima</u>	164	5392	3240	182	542
<u>Navicula arvensis</u>	53	29		2	40
<u>Navicula cryptocephala</u>	2	2	25	10	84
<u>Navicula minima</u>					

Table 3-8-138. Continued.

	Station				
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
CHRY SOPHYTA (Cont.)					
<u>Navicula pelliculosa</u>	8	8	75	1	
<u>Navicula tripunctata</u>					
<u>Navicula vaucheriae</u>					
<u>Navicula viridula</u>					
<u>Navicula sp. 1</u>		2	38	6	52
<u>Navicula sp. 2</u>	4		43	12	5
<u>Navicula sp. 5</u>					
<u>Amphora ovalis var. pediculus</u>					
<u>Cymbella affinis</u>			9		54
<u>Cymbella microcephala</u>					
<u>Cymbella sinuata</u>			1		61
<u>Cymbella ventricosa</u>	1	361	130	1	38
<u>Gomphonema intricatum</u>					
<u>Epithemia sorex</u>					
<u>Rhopalodia gibberula</u>					
<u>Nitzschia chasei</u>					
<u>Nitzschia denticula</u>					
<u>Nitzschia dissipata</u>	1		213	22	87
<u>Nitzschia frustulum</u>					
<u>Nitzschia linearis</u>					
<u>Nitzschia microcephala</u>	9	29	41	45	28
<u>Nitzschia palea</u>					

Table 3-8-139. Mean densities of the major algal taxa observed in the periphyton at the Headwater Stations during RBOSP Aquatic Baseline Studies, July - August 1975. (Data are expressed as cells/mm² except that data for filamentous forms are expressed as the number of 50μ units.)

	Station				
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
CYANOPHYTA					
<u>Lyngbya</u> spp.					
<u>Plectonema</u> spp.					
<u>Calothrix</u> spp.					
CHRYSTOPHYTA					
<u>Bicoeca lacustris</u>	706	35	15	84	
<u>Diatoma vulgare</u>					
<u>Fragilaria vaucheriae</u>					
<u>Synedra amphicephala</u>		12	1	1	11
<u>Synedra famelica</u>					
<u>Synedra minuscula</u>					
<u>Synedra ulna</u>					
<u>Cocconeis placentula</u>					
<u>Achnanthes lanceolata</u>	1	16	39	13	34
<u>Achnanthes minutissima</u>	227	240	74	802	366
<u>Navicula arvensis</u>	7	4	3	6	
<u>Navicula cryptocephala</u>	8	6	78	100	23
<u>Navicula pelliculosa</u>			10	18	9
<u>Navicula salinarum</u> var. <u>intermedia</u>					
<u>Navicula tripunctata</u>					
<u>Navicula vaucheriae</u>					
<u>Navicula viridula</u>					
<u>Navicula</u> sp. 1	1	4	37	12	14
<u>Navicula</u> sp. 2	3	1	38	6	1

Table 3-8-139. Continued.

	Station				
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
CHRYSOPHYTA (Cont.)					
<u>Amphora ovalis</u> var. <u>pediculus</u>					
<u>Cymbella affinis</u>					
<u>Cymbella sinuata</u>					
<u>Cymbella ventricosa</u>					
<u>Gomphonema intricatum</u>	8	20	5	19	10
<u>Gomphonema olivaceum</u>					
<u>Epithemia sorex</u>					
<u>Nitzschia acicularis</u>				4	57
<u>Nitzschia capitellata</u>					
<u>Nitzschia chasei</u>					
<u>Nitzschia denticula</u>					
<u>Nitzschia dissipata</u>					
<u>Nitzschia fonticola</u>					
<u>Nitzschia frustulum</u>	1	1	33	7	70
<u>Nitzschia holsatica</u>			3	13	
<u>Nitzschia linearis</u>	2	2	33	36	58
<u>Nitzschia palea</u>					

Table 3-8-140. Mean densities of the major algal taxa observed in the periphyton at the Headwater Stations during RBOSP Aquatic Baseline Studies, August - September 1975. (Data are expressed as cells/mm² except that data for filamentous forms are expressed as the number of 50 μ units.)

	Station				
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
CHRYSTOPHYTA					
<u>Bicoeca lacustris</u>	5813	77		84	
<u>Achnanthes lanceolata</u>	5	4	40	30	33
<u>Achnanthes minutissima</u>	536	93	32	269	417
<u>Cocconeis placentula</u>					43
<u>Navicula arvensis</u>	12	2	2	36	
<u>Navicula pelliculosa</u>	1		95	13	5
<u>Navicula cryptocephala</u>	20	1	30	118	18
<u>Navicula sp. 1</u>	7		41	75	11
<u>Navicula sp. 2</u>	1	1	61	7	1
<u>Gomphonema intricatum</u>		1	2	26	2
<u>Rhopalodia gibberula</u>			2		30
<u>Nitzschia capitellata</u>	1	0	22	29	
<u>Nitzschia denticula</u>	89	1	2	3	6
<u>Nitzschia frustulum</u>	1	2	46	5	227
<u>Nitzschia palea</u>	10	1	14	17	2

taxa observed at the Headwater stations during the one year sampling period are listed in Table 3-8-141.

The periphyton community of the Headwater stations during October - November 1974 was dominated by diatoms. Most abundant species were Achnanthes minutissima, Synedra amphicephala, and Navicula cryptocephala. At Headwater Station 2 blue-greens (Plectonema spp.) were dominant with 1,321 counting units/mm².

Periphyton communities of December 1974 - January 1975 were dominated by the diatoms Achnanthes minutissima, A. lanceolata, Gomphonema intricatum, and Nitzschia frustulum. Achnanthes minutissima at this time had densities of 17,275 cells/mm², the highest density of any species sampled at the headwater stations during the year.

In the April 1975 collections, the periphyton community was again dominated by the diatoms Achnanthes minutissima, Gomphonema intricatum, and Synedra amphicephala. Densities of Achnanthes minutissima reached 12,402 cells/mm² at Station 1.

Dominant algae in samples from Stations 2 through 5 in May - June 1975 were the diatoms Achnanthes minutissima and Gomphonema intricatum. At Station 1, Bicoeca lacustris (a flagellated chrysophyte) dominated at 4,334 cells/mm² and Achnanthes minutissima was second in abundance with 164 cells/mm².

Low densities of periphytic algae were found in the July - August 1975 headwater samples. The most abundant species were Achnanthes minutissima and Bicoeca lacustris which had mean densities for Stations 1-5 of 342 cells/mm² and 183 cells/mm², respectively.

August - September 1975 samples from Stations 2-5 were dominated by Achnanthes minutissima except at Station 1 where Bicoeca lacustris was again dominant.

Table 3-8-141. Algal taxa observed in the periphyton at the Headwaters during RBOSP Aquatic Baseline Studies between October-November 1974 and August-September 1975.

CYANOPHYTA

Lyngbya spp.
Oscillatoria spp.
Schizothrix spp.
Anabaena spp.
Plectonema spp.
Calothrix spp.
Rivularia spp.

CHLOROPHYTA

Ulothrix spp
Cladophora spp.
Oedogonium spp.
Spirogyra spp.
Zyngnema spp.
Closterium leibleinii

CHRYSTOPHYTA

Chrysophyta I
Bicoeca lacustris
Melosira roseana
Melosira spp.
Cyclotella meneghiniana
Diatoma hiemale
Diatoma tenue var. elongatum
Diatoma vulgare
Meridion circulare
Fragilaria construens
Fragilaria crotonensis
Fragilaria leptostauron
Fragilaria pinnata
Fragilaria vaucheriae
Synedra amphicephala
Synedra famelica
Synedra tenera
Synedra ulna
Synedra spp.
Cocconeis pediculus
Cocconeis placentula
Achnanthes lanceolata
Achnanthes minutissima
Rhoicosphenia curvata
Mastogloia smithii

Table 3-8-141. Continued.

<u>Gyrosigma acuminatum</u>
<u>Pleurosigma delicatulum</u>
<u>Anomoeoneis sphaerophora</u>
<u>Navicula arvensis</u>
<u>Navicula capitata</u>
<u>Navicula cryptocephala</u>
<u>Navicula cuspidata</u>
<u>Navicula fragilarioides</u>
<u>Navicula gregaria</u>
<u>Navicula lanceolata</u>
<u>Navicula minima</u>
<u>Navicula mutica</u>
<u>Navicula oblonga</u>
<u>Navicula pelliculosa</u>
<u>Navicula pygmaea</u>
<u>Navicula radiosa</u>
<u>Navicula rhyncocephala</u>
<u>Navicula salinarum</u>
<u>Navicula seminulum</u>
<u>Navicula tantula</u>
<u>Navicula tripunctata</u>
<u>Navicula vaucheriae</u>
<u>Navicula viridula</u>
<u>Navicula sp. 1</u>
<u>Navicula sp. 2</u>
<u>Navicula sp. 3</u>
<u>Navicula sp. 5</u>
<u>Navicula sp. 6</u>
<u>Caloneis bacillum</u>
<u>Caloneis ventricosa</u>
<u>Pinnularia brebissonii</u>
<u>Pinnularia globiceps</u>
<u>Pinnularia subcapitata</u>
<u>Pinnularia viridis</u>
<u>Amphora montana</u>
<u>Amphora ovalis</u>
<u>Amphora ovalis var. pediculus</u>
<u>Amphora spp.</u>
<u>Amphora sp. 1</u>
<u>Cymbella affinis</u>
<u>Cymbella cistula</u>
<u>Cymbella microcephala</u>
<u>Cymbella sinuata</u>
<u>Cymbella ventricosa</u>
<u>Gomphonema intricatum</u>
<u>Gomphonema lanceolatum</u>
<u>Gomphonema longiceps</u>
<u>Gomphonema olivaceum</u>

Table 3-8-141. Continued.

Gomphonema parvulum
Gomphonema ventricosum
Gomphonema sp. 1
Amphiprora ornata
Epithemia sorex
Epithemia zebra
Epithemia spp.
Rhopalodia gibba
Rhopalodia gibberula
Cylindrotheca gracilis
Hantzschia amphioxys
Nitzschia acicularis
Nitzschia amphibia
Nitzschia apiculata
Nitzschia baccata
Nitzschia capitellata
Nitzschia chasei
Nitzschia denticula
Nitzschia dissipata
Nitzschia fonticola
Nitzschia frustulum
Nitzschia gracilis
Nitzschia holsatica
Nitzschia lanceolata
Nitzschia linearis
Nitzschia microcephala
Nitzschia palea
Nitzschia sigmoidea
Nitzschia tryblionella
Nitzschia spp.
Nitzschia sp. 1
Surirella angustata
Surirella ovata
Surirella ovalis

CRYPTOPHYTA

Cryptomonas erosa

b. Tract C-a - Densities of major periphyton taxa of Tract stations (6-18) from October 1974 to September 1975 are summarized in Tables 3-8-142 through 3-8-147. Algal taxa observed from the Tract stations during the one year sampling period are listed in Table 3-8-148.

The periphyton of the Tract stations during all sampling periods was dominated by Achnanthes minutissima; highest mean cell densities were 5,990 cells/mm² in April 1975, 5,971 cells/mm² in September 1975 and 5,662 cells/mm² in December 1974 - January 1975. Navicula cryptocephala was second in abundance in the October - November 1974 and December 1974 - January 1975 samples. In the April, May - June and July - August 1975 samples, Nitzschia denticula was second in abundance while the August - September 1975 samples had Cymbella affinis second in abundance and Nitzschia denticula was the third most abundant taxon.

c. Yellow Creek - Densities of dominant periphyton taxa at the lower Yellow Creek stations (19-22) from October 1974 to September 1975 are summarized in Tables 3-8-149 through 3-8-157. Alga taxa observed from the lower Yellow Creek stations during the one year sampling period are listed in Table 3-8-158.

Most abundant periphytic algae at Stations 20-22 of the October - November 1974 sampling were Cymbella affinis and Achnanthes minutissima. The periphyton community at Station 19 had low algal cell densities and was dominated by Rhopalodia gibberula and Nitzschia frustulum.

Only Station 19 was sampled from the lower Yellow Creek area in December 1974 - January 1975. The periphyton community was dominated by the diatoms Surirella ovata, Synedra amphicephala, Nitzschia frustulum, Navicula cryptocephala, Navicula viridula and Nitzschia palea.

Most abundant species in the April 1975 periphyton samples from Stations 20-22 were Navicula pelliculosa, Achnanthes minutissima, Surirella ovata and Fragilaria vaucheriae. Station 19 was dominated by the filamentous

Table 3-8-142. Mean densities of the major algal taxa observed in the periphyton at the Tract Stations during RBOSP Aquatic Baseline Studies, October - November 1974. (Data are expressed as cells/mm² except that data for filamentous forms are expressed as the number of 50 μ units.)

	Station				
	<u>7</u>	<u>8</u>	<u>9</u>	<u>13</u>	<u>14</u>
CYANOPHYTA					
<u>Lyngbya</u> spp.			237	956	
<u>Oscillatoria</u> spp.					
<u>Plectonema</u> spp.				518	
<u>Calothrix</u> spp.					
CHLOROPHYTA					
<u>Ulothrix</u> spp.	470			349	14
CHRYSTOPHYTA					
<u>Cyclotella</u> <u>meneghiniana</u>					
<u>Diatoma</u> <u>vulgare</u>					
<u>Meridion</u> <u>circulare</u>			5	281	
<u>Fragilaria</u> <u>vaucheriae</u>					
<u>Synedra</u> <u>amphicephala</u>		5	51	68	11
<u>Synedra</u> <u>ulna</u>					
<u>Achnanthes</u> <u>lanceolata</u>	70	17	2	653	2
<u>Achnanthes</u> <u>minutissima</u>	1924	28	577	5378	641
<u>Pleurosigma</u> <u>delicatulum</u>					
<u>Navicula</u> <u>cryptocephala</u>	25	5	22	7223	9
<u>Navicula</u> <u>pelliculosa</u>					
<u>Navicula</u> <u>salinarum</u> var. <u>intermedia</u>					

ⁱ Stations 6, 10-12 and 15-18 were dry at the time of sampling.

Table 3-8-142. Continued.

	Stations				
	<u>7</u>	<u>8</u>	<u>9</u>	<u>13</u>	<u>14</u>
<u>Navicula tripunctata</u>					
<u>Navicula sp. 1</u>					
<u>Cymbella affinis</u>					
<u>Cymbella pusilla</u>					
<u>Gomphonema angustatum</u>				203	
<u>Gomphonema intricatum</u>				428	
<u>Gomphonema olivaceum</u>			1	146	
<u>Gomphonema ventricosum</u>					
<u>Epithemia sorex</u>					
<u>Rhopalodia gibberula</u>					
<u>Nitzschia dissipata</u>					
<u>Nitzschia frustulum</u>	52		16	158	34
<u>Nitzschia linearis</u>			5	214	2
<u>Nitzschia palea</u>	5	1	8	281	9

Table 3-8-143. Mean densities of the major algal taxa observed in the periphyton at the Tract Stations during RBOSP Aquatic Baseline Studies, December 1974 - January 1975. (Data are expressed as cells/mm² except that data for filamentous forms are expressed as the number of 50 μ units.)

	Station			
	<u>8</u>	<u>9</u>	<u>13</u>	<u>14</u>
CYANOPHYTA				
<u>Lyngbya</u> spp.		93	5	
<u>Calothrix</u> spp.				
CHLOROPHYTA				
<u>Zygnema</u> spp.				
CHRYSTOPHYTA				
<u>Diatoma</u> <u>hiemale</u>	9	58		14
<u>Diatoma</u> <u>vulgare</u>				
<u>Meridion</u> <u>circulare</u>				
<u>Fragilaria</u> <u>vaucheriae</u>				
<u>Synedra</u> <u>amphicephala</u>	2		79	1141
<u>Synedra</u> <u>ulna</u>	1	4	35	115
<u>Cocconeis</u> <u>pediculus</u>				
<u>Achnanthes</u> <u>lanceolata</u>	31	86	94	
<u>Achnanthes</u> <u>minutissima</u>	163	243	11690	10550
<u>Navicula</u> <u>arvensis</u>				
<u>Navicula</u> <u>cryptocephala</u>		28	2699	67
<u>Navicula</u> <u>minima</u>				

¹ Stations 6, 7, 10-12 and 15-18 were inaccessible, frozen solid or ice covered during sampling period.

Table 3-8-143. Continued.

	Station			
	<u>8</u>	<u>9</u>	<u>13</u>	<u>14</u>
CHRYSTOPHYTA (Cont.)				
<u>Navicula pelliculosa</u>				
<u>Navicula salinarum</u> var. <u>intermedia</u>				
<u>Navicula tripunctata</u>				
<u>Navicula viridula</u>				
<u>Amphora ovalis</u>				
<u>Amphora ovalis</u> var. <u>pediculus</u>				
<u>Cymbella affinis</u>			31	1091
<u>Gomphonema intricatum</u>	7	2	439	65
<u>Gomphonema olivaceum</u>				
<u>Gomphonema ventricosum</u>				
<u>Epithemia sorex</u>	5	8	63	14
<u>Nitzschia apiculata</u>				65
<u>Nitzschia baccata</u>				1139
<u>Nitzschia denticula</u>				
<u>Nitzschia dissipata</u>				
<u>Nitzschia frustulum</u>	7		45	374
<u>Nitzschia linearis</u>		50	137	
<u>Nitzschia palea</u>	1		23	29
<u>Surirella ovata</u>				

Table 3-8-144. Mean densities of the major algal taxa observed in the periphyton at the Tract Stations during RBOSP Aquatic Baseline Studies, April 1975. (Data are expressed as cells/mm² except that data for filamentous forms are expressed as the number of 50 μ units.)

	Station				
	<u>7</u>	<u>8</u>	<u>9</u>	<u>13</u>	<u>14</u>
CYANOPHYTA					
<u>Lyngbya</u> spp.					
<u>Plectonema</u> spp.	461	589	31		
<u>Calothrix</u> spp.					
CHLOROPHYTA					
<u>Ulothrix</u> spp.					
CHRYSTOPHYTA					
<u>Meridion</u> <u>circulare</u>					
<u>Fragilaria</u> <u>vaucheriae</u>					
<u>Synedra</u> <u>amphicephala</u>	2			7	150
<u>Achnanthes</u> <u>lanceolata</u>	23	84	19	288	247
<u>Achnanthes</u> <u>minutissima</u>	2236	6780	1497	4481	4954
<u>Navicula</u> <u>arvensis</u>	9	303	5	69	199
<u>Navicula</u> <u>cryptocephala</u>	9		20	830	435
<u>Navicula</u> <u>pelliculosa</u>	2	23	27	120	154
<u>Navicula</u> <u>salinarum</u> var. <u>intermedia</u>					
<u>Navicula</u> <u>tripunctata</u>					
<u>Navicula</u> <u>viridula</u>				7	168
<u>Navicula</u> sp. 1	23		9	9	56
<u>Navicula</u> sp. 2	18			13	68
<u>Amphora</u> <u>ovalis</u> var. <u>pediculus</u>					
<u>Cymbella</u> <u>affinis</u>	7	127		15	199

¹ Stations 6, 10-12 and 15-18 were dry at the time of sampling.

Table 3-8-143. Continued.

	Station			
	<u>8</u>	<u>9</u>	<u>13</u>	<u>14</u>
CHRYSTOPHYTA (Cont.)				
<u>Navicula pelliculosa</u>				
<u>Navicula salinarum</u> var. <u>intermedia</u>				
<u>Navicula tripunctata</u>				
<u>Navicula viridula</u>				
<u>Amphora ovalis</u>				
<u>Amphora ovalis</u> var. <u>pediculus</u>				
<u>Cymbella affinis</u>			31	1091
<u>Gomphonema intricatum</u>	7	2	439	65
<u>Gomphonema olivaceum</u>				
<u>Gomphonema ventricosum</u>				
<u>Epithemia sorex</u>	5	8	63	14
<u>Nitzschia apiculata</u>				65
<u>Nitzschia baccata</u>				1139
<u>Nitzschia denticula</u>				
<u>Nitzschia dissipata</u>				
<u>Nitzschia frustulum</u>	7		45	374
<u>Nitzschia linearis</u>		50	137	
<u>Nitzschia palea</u>	1		23	29
<u>Surirella ovata</u>				

Table 3-8-144. Mean densities of the major algal taxa observed in the periphyton at the Tract Stations during RBOSP Aquatic Baseline Studies, April 1975. (Data are expressed as cells/mm² except that data for filamentous forms are expressed as the number of 50 μ units.)

	Station				
	<u>7</u>	<u>8</u>	<u>9</u>	<u>13</u>	<u>14</u>
CYANOPHYTA					
<u>Lyngbya</u> spp.					
<u>Plectonema</u> spp.	461	589	31		
<u>Calothrix</u> spp.					
CHLOROPHYTA					
<u>Ulothrix</u> spp.					
CHRY SOPHYTA					
<u>Meridion</u> <u>circulare</u>					
<u>Fragilaria</u> <u>vaucheriae</u>					
<u>Synedra</u> <u>amphicephala</u>	2			7	150
<u>Achnanthes</u> <u>lanceolata</u>	23	84	19	288	247
<u>Achnanthes</u> <u>minutissima</u>	2236	6780	1497	4481	4954
<u>Navicula</u> <u>arvensis</u>	9	303	5	69	199
<u>Navicula</u> <u>cryptocephala</u>	9		20	830	435
<u>Navicula</u> <u>pelliculosa</u>	2	23	27	120	154
<u>Navicula</u> <u>salinarum</u> var. <u>intermedia</u>					
<u>Navicula</u> <u>tripunctata</u>					
<u>Navicula</u> <u>viridula</u>				7	168
<u>Navicula</u> sp. 1	23		9	9	56
<u>Navicula</u> sp. 2	18			13	68
<u>Amphora</u> <u>ovalis</u> var. <u>pediculus</u>					
<u>Cymbella</u> <u>affinis</u>	7	127		15	199

¹ Stations 6, 10-12 and 15-18 were dry at the time of sampling.

Table 3-8-144. Continued.

	Station				
	<u>7</u>	<u>8</u>	<u>9</u>	<u>13</u>	<u>14</u>
CHRYSTOPHYTA (Cont.)					
<u>Cymbella ventricosa</u>					
<u>Gomphonema intricatum</u>	5	1722	9	98	23
<u>Gomphonema olivaceum</u>					
<u>Epithemia sorex</u>					
<u>Rhopalodia gibberula</u>					
<u>Nitzschia chasei</u>					
<u>Nitzschia denticula</u>	52	,	27	45	1688
<u>Nitzschia dissipata</u>					
<u>Nitzschia frustulum</u>	40	9	21	125	1069
<u>Nitzschia linearis</u>					
<u>Nitzschia palea</u>	2			30	171
<u>Surirella ovata</u>					

Table 3-8-145. Mean densities of the major algal taxa observed in the periphyton at the Tract Stations during RBOSP Aquatic Baseline Studies, May - June 1975. (Data are expressed as cells/mm² except that data for filamentous forms are expressed as the number of 50 μ units.)

	Station					
	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>13</u>	<u>14</u>
CYANOPHYTA						
<u>Lyngbya</u> spp.						
<u>Schizothrix</u> spp.						
<u>Plectonema</u> spp.						
<u>Calothrix</u> spp.						
CHLOROPHYTA						
<u>Cladophora</u> spp.						
CHRYSTOPHYTA						
<u>Bicoeca lacustris</u>						
<u>Cyclotella meneghiniana</u>					3	37
<u>Fragilaria vaucheriae</u>	1					
<u>Synedra amphicephala</u>	1	2		3		176
<u>Synedra pulchella</u>						
<u>Synedra ulna</u>						259
<u>Achnanthes lanceolata</u>						
<u>Achnanthes minutissima</u>	135	277	32	105	29	6390
<u>Navicula arvensis</u>						
<u>Navicula cryptocephala</u>	6	38	1	16	9	279
<u>Navicula minima</u>						

Table 3-8-145. Continued.

	Station					
	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>13</u>	<u>14</u>
CHRYSOPHYTA (Cont.)						
<u>Navicula pelliculosa</u>						
<u>Navicula tripunctata</u>						
<u>Navicula vaucheriae</u>						
<u>Navicula viridula</u>						
<u>Navicula sp. 1</u>		9	1	3	3	75
<u>Navicula sp. 2</u>	1	16	1	4	2	18
<u>Navicula sp. 5</u>						114
<u>Amphora ovalis var. pediculus</u>						
<u>Cymbella affinis</u>	2	27		3	1	553
<u>Cymbella microcephala</u>					1	37
<u>Cymbella sinuata</u>						
<u>Cymbella ventricosa</u>						
<u>Gomphonema intricatum</u>	5	11	3	1	6	5
<u>Epithemia sorex</u>						
<u>Rhopalodia gibberula</u>						
<u>Nitzschia chasei</u>						
<u>Nitzschia denticula</u>		31	1	30		4680
<u>Nitzschia dissipata</u>						
<u>Nitzschia frustulum</u>	6	73	2	35	6	313
<u>Nitzschia linearis</u>	1	20		5		5
<u>Nitzschia microcephala</u>						
<u>Nitzschia palea</u>	1	13	2	2	3	9

Table 3-8-146. Mean densities of the major algal taxa observed in the periphyton at the Tract Stations during RBOSP Aquatic Baseline Studies, July - August 1975. (Data are expressed as cells/mm² except that data for filamentous forms are expressed as the number of 50 μ units.)

	Station							
	<u>7</u>	<u>8</u>	<u>9</u>	<u>13</u>	<u>14</u>	<u>15</u>	<u>17</u>	<u>18</u>
CYANOPHYTA								
<u>Lyngbya</u> spp.					367			
<u>Plectonema</u> spp.								
<u>Calothrix</u> spp.								
CHRYSTOPHYTA								
<u>Bicoeca lacustris</u>	7	575	138		37		22	
<u>Diatoma vulgare</u>								
<u>Fragilaria vaucheriae</u>								
<u>Synedra amphicephala</u>					360			
<u>Synedra famelica</u>					658	528	8	
<u>Synedra minuscula</u>					912	2121	60	4
<u>Synedra ulna</u>	1	2						
<u>Cocconeis placentula</u>								
<u>Achnanthes lanceolata</u>	1284	315	174	836	11494	820	21	33
<u>Achnanthes minutissima</u>								
<u>Navicula arvensis</u>	38	3	9	192	315	1349	35	61
<u>Navicula cryptocephala</u>	3	2		172	60	308	679	13
<u>Navicula pelliculosa</u>								
<u>Navicula salinarum</u> var. <u>intermedia</u>								
<u>Navicula tripunctata</u>								
<u>Navicula vaucheriae</u>								
<u>Navicula viridula</u>								
<u>Navicula</u> sp. 1								
<u>Navicula</u> sp. 2								

¹ Stations 6, 10-12 and 16 were dry at the time of sampling.

Table 3-8-146. Continued.

	Station							
	<u>7</u>	<u>8</u>	<u>9</u>	<u>13</u>	<u>14</u>	<u>15</u>	<u>17</u>	<u>18</u>
CHRYSTOPHYTA (Cont.)								
<u>Amphora ovalis</u> var. <u>pediculus</u>								
<u>Cymbella affinis</u>	2	2	5	7	1481	15		
<u>Cymbella microcephala</u>					109	187	8	
<u>Cymbella sinuata</u>								
<u>Cymbella ventricosa</u>					17	745		41
<u>Gomphonema intricatum</u>								
<u>Gomphonema olivaceum</u>								
<u>Epithemia sorex</u>								
<u>Nitzschia acicularis</u>	1		1		180	879	152	4
<u>Nitzschia capitellata</u>	6			70	7	1252	197	23
<u>Nitzschia chasei</u>								
<u>Nitzschia denticula</u>	38		13		2124	1657	32	
<u>Nitzschia dissipata</u>								
<u>Nitzschia fonticola</u>								
<u>Nitzschia frustulum</u>								
<u>Nitzschia holsatica</u>		2		57	729	1503	86	105
<u>Nitzschia linearis</u>								
<u>Nitzschia palea</u>								

Table 3-8-147. Mean densities of the major algal taxa observed in the periphyton at the Tract Stations during RBOSP Aquatic Baseline Studies, August - September 1975. (Data are expressed as cells/mm² except that data for filamentous forms are expressed as the number of 50μ units.)

	Station						
	7	8	9	12	13	14	17
CYANOPHYTA							
<u>Lyngbya</u> spp.					980	30	
CHRYSTOPHYTA							
<u>Bicoeca lacustris</u>		1057			652		
<u>Cyclotella meneghiniana</u>						211	6
<u>Achnanthes minutissima</u>	3069	110	5313	20	19442	9858	11
<u>Navicula cryptocephala</u>	15	31	43	2	197	165	7
<u>Navicula pelliculosa</u>	13	1	1		199	3	6
<u>Navicula</u> sp. 1	7		31	4	2	45	73
<u>Cymbella affinis</u>		1	7	3	220	4140	2
<u>Cymbella ventricosa</u>			1		6	208	2
<u>Gomphonema intricatum</u>	1	48			17	226	
<u>Nitzschia denticula</u>	3		84	4	63	1969	
<u>Nitzschia frustulum</u>	10	2	23	14	22	27	88
<u>Nitzschia palea</u>		12	4	66	28	20	56

Table 3-8-148. Algal taxa observed in the periphyton at the Tract Stations during RBOSP Aquatic Baseline Studies between October-November 1974 and August-September 1975.

CYANOPHYTA

Merismopedia glauca
Lyngbya spp.
Oscillatoria spp.
Plectonema spp.
Calothrix spp.

CHLOROPHYTA

Ulothrix spp.
Cladophora spp.
Scenedesmus incrassatulus
Spirogyra spp.
Zygnema spp.
Closterium leibleinii
Closterium moniliferum

CHRYSTOPHYTA

Chrysophyta I
Bicoeca lacustris
Chrysidiastrium ocellatum
Cyclotella meneghiniana
Stephanodiscus tenuis
Diatoma hiemale
Diatoma tenue var. elongatum
Diatoma vulgare
Meridion circulare
Fragilaria capucina
Fragilaria construens
Fragilaria crotonensis
Fragilaria pinnata
Fragilaria vaucheriae
Synedra amphicephala
Synedra famelica
Synedra minuscula
Synedra rumpens
Synedra tenera
Synedra ulna
Cocconeis pediculus
Cocconeis placentula
Achnanthes lanceolata
Achnanthes minutissima
Rhoicosphenia curvata

Table 3-8-148. Continued.

Mastogloia smithii
Amphipleura pellucida
Gyrosigma acuminatum
Pleurosigma delicatulum
Pleurosigma salinarum
Stauroneis spp.
Anomoeoneis sphaerophora
Navicula arvensis
Navicula cryptocephala
Navicula cuspidata
Navicula gregaria
Navicula mutica
Navicula pelliculosa
Navicula rhyncocephala
Navicula salinarum
Navicula salinarum var. intermedia
Navicula seminulum
Navicula tantula
Navicula tripunctata
Navicula vaucheriae
Navicula viridula
Navicula sp. 1
Navicula sp. 2
Navicula sp. 4
Navicula sp. 5
Navicula sp. 6
Caloneis amphisbaena
Caloneis bacillum
Caloneis ventricosa
Pinnularia borealis
Pinnularia brebissonii
Pinnularia viridis
Amphora montana
Amphora ovalis
Amphora ovalis var. pediculus
Amphora sp. 1
Cymbella affinis
Cymbella cistula
Cymbella microcephala
Cymbella obtusiuscula
Cymbella sinuata
Cymbella ventricosa
Gomphonema angustatum
Gomphonema intricatum
Gomphonema olivaceum
Gomphonema parvulum
Gomphonema ventricosum
Epithemia sorex

Table 3-8-148. Continued.

Rhopalodia gibba
Rhopalodia gibberula
Cylindrotheca gracilis
Hantzschia amphioxys
Nitzschia acicularis
Nitzschia amphibia
Nitzschia apiculata
Nitzschia baccata
Nitzschia capitellata
Nitzschia chasei
Nitzschia denticula
Nitzschia dissipata
Nitzschia fonticola
Nitzschia frustulum
Nitzschia gracilis
Nitzschia holsatica
Nitzschia linearis
Nitzschia microcephala
Nitzschia palea
Nitzschia vermicularis
Cymatopleura solea
Surirella angustata
Surirella ovata
Surirella ovalis

Table 3-8-149. Mean densities of the major algal taxa observed in the periphyton at the Yellow Creek Stations during RBOSP Aquatic Baseline Studies, October - November 1974. (Data are expressed as cells/mm² except that data for filamentous forms are expressed as the number of 50 μ units.)

	Station			
	<u>19</u>	<u>20</u>	<u>21</u>	<u>22</u>
CYANOPHYTA				
<u>Lyngbya</u> spp.		68		
<u>Oscillatoria</u> spp.				
<u>Plectonema</u> spp.				
<u>Calothrix</u> spp.	14	2059	540	9
CHLOROPHYTA				
<u>Ulothrix</u> spp.				
CHRYSTOPHYTA				
<u>Cyclotella meneghiniana</u>	7	855	236	18
<u>Diatoma vulgare</u>				
<u>Meridion circulare</u>				
<u>Fragilaria vaucheriae</u>	32	90	23	27
<u>Synedra amphicephala</u>	31	11	34	
<u>Synedra ulna</u>	16	214	79	36
<u>Achnanthes lanceolata</u>				
<u>Achnanthes minutissima</u>	38	7718	5996	3128
<u>Pleurosigma delicatulum</u>				
<u>Navicula cryptocephala</u>	74	214	45	54
<u>Navicula pelliculosa</u>				
<u>Navicula salinarum</u> var. <u>intermedia</u>				

Table 3-8-149. Continued.

	Station			
	<u>19</u>	<u>20</u>	<u>21</u>	<u>22</u>
<u>Navicula tripunctata</u>				
<u>Navicula sp. 1</u>				
<u>Cymbella affinis</u>	2	7830	9034	4289
<u>Cymbella pusilla</u>		23	113	36
<u>Gomphonema angustatum</u>				
<u>Gomphonema intricatum</u>		45	11	5
<u>Gomphonema olivaceum</u>				
<u>Gomphonema ventricosum</u>				
<u>Epithemia sorex</u>	14	23		
<u>Rhopalodia gibberula</u>	333			
<u>Nitzschia dissipata</u>				
<u>Nitzschia frustulum</u>	173	124	68	23
<u>Nitzschia linearis</u>				
<u>Nitzschia palea</u>	43	45	101	27

Table 3-8-150. Mean densities of the major algal taxa observed in the periphyton at the Yellow Creek Stations during RBOSP Aquatic Baseline Studies, December 1974 - January 1975. (Data are expressed as cells/mm² except that data for filamentous forms are expressed as the number of 50 μ units.)

	Station
CYANOPHYTA	<u>19</u>
<u>Lyngbya</u> spp.	
<u>Calothrix</u> spp.	
CHLOROPHYTA	
<u>Zygnema</u> spp.	
CHRYSTOPHYTA	
<u>Diatoma</u> <u>hiemale</u>	
<u>Diatoma</u> <u>vulgare</u>	
<u>Meridion</u> <u>circularae</u>	
<u>Fragilaria</u> <u>vaucheriae</u>	
<u>Synedra</u> <u>amphicephala</u>	2363
<u>Synedra</u> <u>ulna</u>	135
<u>Cocconeis</u> <u>pediculus</u>	135
<u>Achnanthes</u> <u>lanceolata</u>	281
<u>Achnanthes</u> <u>minutissima</u>	349
<u>Navicula</u> <u>arvensis</u>	135
<u>Navicula</u> <u>cryptocephala</u>	1868
<u>Navicula</u> <u>minima</u>	

¹ Stations 20-22 were frozen solid during the time of sampling.

Table 3-8-150. Continued.

	Station
	<u>19</u>
CHRYSTOPHYTA (Cont.)	
<u>Navicula pelliculosa</u>	180
<u>Navicula salinarum</u> var. <u>intermedia</u>	
<u>Navicula tripunctata</u>	
<u>Navicula viridula</u>	923
<u>Amphora ovalis</u>	
<u>Amphora ovalis</u> var. <u>pediculus</u>	
<u>Cymbella affinis</u>	
<u>Gomphonema intricatum</u>	
<u>Gomphonema olivaceum</u>	135
<u>Gomphonema ventricosum</u>	
<u>Epithemia sorex</u>	
<u>Nitzschia apiculata</u>	360
<u>Nitzschia baccata</u>	
<u>Nitzschia denticula</u>	
<u>Nitzschia dissipata</u>	
<u>Nitzschia frustulum</u>	2228
<u>Nitzschia linearis</u>	271
<u>Nitzschia palea</u>	968
<u>Surirella ovata</u>	6041

Table 3-8-151. Mean densities of the major algal taxa observed in the periphyton at the Yellow Creek Stations during RBOSP Aquatic Baseline Studies, April 1975. (Data are expressed as cells/mm² except that data for filamentous forms are expressed as the number of 50 μ units.)

	Station			
	19	20	21	22
CYANOPHYTA				
<u>Lyngbya</u> spp.				
<u>Plectonema</u> spp.	76			
<u>Calothrix</u> spp.	360			
CHLOROPHYTA				
<u>Ulothrix</u> spp.				
CHRYSOPHYTA				
<u>Meridion</u> <u>circulare</u>				
<u>Fragilaria</u> <u>vaucheriae</u>	7	108	162	194
<u>Synedra</u> <u>amphicephala</u>	64	9	9	5
<u>Achnanthes</u> <u>lanceolata</u>				
<u>Achnanthes</u> <u>minutissima</u>	82	1337	977	2205
<u>Navicula</u> <u>arvensis</u>	251		23	
<u>Navicula</u> <u>cryptocephala</u>	510	36	13	36
<u>Navicula</u> <u>pelliculosa</u>	45	578	4005	3137
<u>Navicula</u> <u>salinarum</u> var. <u>intermedia</u>				
<u>Navicula</u> <u>tripunctata</u>				
<u>Navicula</u> <u>viridula</u>				
<u>Navicula</u> sp. 1	135	5	5	5
<u>Navicula</u> sp. 2				
<u>Amphora</u> <u>ovalis</u> var. <u>pediculus</u>				
<u>Cymbella</u> <u>affinis</u>	7	63	36	207

Table 3-8-151. Continued.

	Station			
	<u>19</u>	<u>20</u>	<u>21</u>	<u>22</u>
CHRYSTOPHYTA (Cont.)				
<u>Cymbella ventricosa</u>				
<u>Gomphonema intricatum</u>				
<u>Gomphonema olivaceum</u>				
<u>Epithemia sorex</u>				
<u>Rhopalodia gibberula</u>	218			
<u>Nitzschia chasei</u>				
<u>Nitzschia denticula</u>				
<u>Nitzschia dissipata</u>				
<u>Nitzschia frustulum</u>	262	32	40	81
<u>Nitzschia linearis</u>				
<u>Nitzschia palea</u>	165	45	58	27
<u>Surirella ovata</u>	202	243	266	284

Table 3-8-152. Mean densities of the major algal taxa observed in the periphyton at the Yellow Creek Stations during RBOSP Aquatic Baseline Studies, May - June 1975. (Data are expressed as cells/mm² except that data for filamentous forms are expressed as the number of 50 μ units.)

	Station			
	19	20	21	22
CYANOPHYTA				
<u>Lyngbya</u> spp.	56	108	108	30
<u>Schizothrix</u> spp.				
<u>Plectonema</u> spp.			596	120
<u>Calothrix</u> spp.	45	14	9	1125
CHLOROPHYTA				
<u>Cladophora</u> spp.				
CHRYSTOPHYTA				
<u>Bicoeca lacustris</u>				
<u>Cyclotella meneghiniana</u>	19	55	86	165
<u>Fragilaria vaucheriae</u>				
<u>Synedra amphicephala</u>		2	5	105
<u>Synedra pulchella</u>				
<u>Synedra ulna</u>				
<u>Achnanthes lanceolata</u>				
<u>Achnanthes minutissima</u>	3832	3758	2142	3525
<u>Navicula arvensis</u>				
<u>Navicula cryptocephala</u>	566	10	20	172
<u>Navicula minima</u>				

Table 3-8-152. Continued.

	Station			
	<u>19</u>	<u>20</u>	<u>21</u>	<u>22</u>
CHRYSTOPHYTA (Cont.)				
<u>Navicula pelliculosa</u>	11	17	12	135
<u>Navicula tripunctata</u>				
<u>Navicula vaucheriae</u>				
<u>Navicula viridula</u>				
<u>Navicula sp. 1</u>	225			7
<u>Navicula sp. 2</u>				
<u>Navicula sp. 5</u>				
<u>Amphora ovalis var. pediculus</u>				
<u>Cymbella affinis</u>				
<u>Cymbella microcephala</u>				
<u>Cymbella sinuata</u>				
<u>Cymbella ventricosa</u>		46	38	38
<u>Gomphonema intricatum</u>				
<u>Epithemia sorex</u>				
<u>Rhopalodia gibberula</u>	465			
<u>Nitzschia chasei</u>				
<u>Nitzschia denticula</u>	3258		5	
<u>Nitzschia dissipata</u>				
<u>Nitzschia frustulum</u>	870	2	180	952
<u>Nitzschia linearis</u>				
<u>Nitzschia microcephala</u>	64		43	22
<u>Nitzschia palea</u>	300	7	135	38

Table 3-8-153. Mean densities of the major algal taxa observed in the periphyton at the Yellow Creek Stations during RBOSP Aquatic Baseline Studies, July - August 1975. (Data are expressed as cells/mm² except that data for filamentous forms are expressed as the number of 50 μ units.)

	Station			
	<u>19</u>	<u>20</u>	<u>21</u>	<u>22</u>
CYANOPHYTA				
<u>Lyngbya</u> spp.	175	15	456	2
<u>Plectonema</u> spp.				
<u>Calothrix</u> spp.				
CHRYSTOPHYTA				
<u>Bicoeca lacustris</u>	13		127	
<u>Diatoma vulgare</u>				
<u>Fragilaria vaucheriae</u>				
<u>Synedra amphicephala</u>				
<u>Synedra famelica</u>				
<u>Synedra minuscula</u>				
<u>Synedra ulna</u>		14	143	10
<u>Cocconeis placentula</u>				
<u>Achnanthes lanceolata</u>				
<u>Achnanthes minutissima</u>	50	85	281	15
<u>Navicula arvensis</u>				
<u>Navicula cryptocephala</u>	721	111	158	28
<u>Navicula pelliculosa</u>	88	123	18	1493
<u>Navicula salinarum</u> var. <u>intermedia</u>				
<u>Navicula tripunctata</u>				
<u>Navicula vaucheriae</u>				
<u>Navicula viridula</u>	70	35	37	47
<u>Navicula</u> sp. 1	142	8	5	5
<u>Navicula</u> sp. 2				

Table 3-8-153. Continued.

	Station			
	19	20	21	22
CHRY SOPHYTA (Cont.)				
<u>Amphora ovalis</u> var. <u>pediculus</u>	12	6	192	4
<u>Cymbella affinis</u>				
<u>Cymbella sinuata</u>				
<u>Cymbella ventricosa</u>	84	24	41	4
<u>Gomphonema intricatum</u>				
<u>Gomphonema olivaceum</u>	9	25	97	
<u>Epithemia sorex</u>				
<u>Nitzschia acicularis</u>				
<u>Nitzschia capitellata</u>				
<u>Nitzschia chasei</u>				
<u>Nitzschia denticula</u>				
<u>Nitzschia dissipata</u>				
<u>Nitzschia fonticola</u>	581	128	291	139
<u>Nitzschia frustulum</u>	678	64	100	35
<u>Nitzschia holsatica</u>	165	32	51	79
<u>Nitzschia linearis</u>				
<u>Nitzschia palea</u>	44	22	59	25

Table 3-8-154. Mean densities of the major algal taxa observed in the periphyton at the Yellow Creek Stations during RBOSP Aquatic Baseline Studies, August - September 1975. (Data are expressed as cells/mm² except that data for filamentous forms are expressed as the number of 50 μ units.)

	Station			
	19	20	21	22
CYANOPHYTA				
<u>Lyngbya</u> spp.	9	3	17	96
<u>Calothrix</u> spp.		9	10	
CHRYSTOPHYTA				
<u>Cyclotella meneghiniana</u>	11	3	20	7
<u>Synedra puehella</u>	11	4	'9	
<u>Achnanthes minutissima</u>	2535	1132	653	950
<u>Navicula cryptocephala</u>	15	12	11	84
<u>Navicula viridula</u>	42	22	16	24
<u>Cymbella ventricosa</u>	52	28	15	73
<u>Gomphonema intricatum</u>		2	39	58
<u>Gomphonema parvulum</u>	17	1		
<u>Nitzschia capitellata</u>			7	15
<u>Nitzschia fonticola</u>	52	20	3	263
<u>Nitzschia frustulum</u>	44	24	98	654
<u>Nitzschia latens</u>			117	
<u>Nitzschia palea</u>	144	42		366

Table 3-8-155. Mean densities of the major algal taxa observed in the periphyton from artificial substrates at the Yellow Creek Stations during RBOSP Aquatic Baseline Studies, May - June, 1975.

	Station	
	<u>20</u>	<u>21</u>
CYANOPHYTA		
<u>Plectonema</u> spp.	3	11
CHRYSTOPHYTA		
<u>Cyclotella</u> <u>meneghiniana</u>	29	144
<u>Synedra</u> <u>amphicephala</u>		7
<u>Synedra</u> <u>pulchella</u>	2	20
<u>Achnanthes</u> <u>minutissima</u>	2364	3224
<u>Navicula</u> <u>cryptocephala</u>	5	23
<u>Cymbella</u> <u>affinis</u>	11	9
<u>Cymbella</u> <u>sinuata</u>		
<u>Cymbella</u> <u>ventricosa</u>	16	16
<u>Gomphonema</u> <u>intricatum</u>		45
<u>Gomphonema</u> <u>olivaceum</u>		
<u>Nitzschia</u> <u>frustulum</u>		29
<u>Nitzschia</u> <u>palea</u>	11	72
<u>Surirella</u> <u>ovata</u>		27

Table 3-8-156. Mean densities of the major algal taxa observed in the periphyton from artificial substrates at the Yellow Creek Stations during RBOSP Aquatic Baseline Studies, July - August 1975.

	Station	
	20	21
CYANOPHYTA		
<u>Lyngbya</u> spp.	11	3
<u>Oscillatoria</u> spp.	4	10
CHRYSTOPHYTA		
<u>Cyclotella</u> <u>meneghiniana</u>	11	26
<u>Synedra</u> <u>puchella</u>		1
<u>Achnanthes</u> <u>minutissima</u>	226	18
<u>Navicula</u> <u>arvensis</u>	2	1
<u>Navicula</u> <u>viridula</u>	5	5
<u>Cymbella</u> <u>ventricosa</u>	44	16
<u>Gomphonema</u> <u>intricatum</u>	13	
<u>Nitzschia</u> <u>apiculata</u>		2
<u>Nitzschia</u> <u>capitellata</u>	1	15
<u>Nitzschia</u> <u>fonticola</u>	20	17
<u>Nitzschia</u> <u>frustulum</u>	12	8
<u>Nitzschia</u> <u>holsatica</u>	4	33
<u>Nitzschia</u> <u>palea</u>	10	68

Table 3-8-157. Mean densities of the major algal taxa observed in the periphyton from artificial substrates at the Yellow Creek Stations during RBOSP Aquatic Baseline Studies, August - September 1975.

	Station	
	<u>20</u>	<u>21</u>
CYANOPHYTA		
<u>Lyngbya</u> spp.	1	67
CHRYSTOPHYTA		
<u>Achnanthes minutissima</u>	155	391
<u>Navicula cryptocephala</u>	1	3
<u>Navicula salinarium</u> v. <u>intermedia</u>		
<u>Navicula tripunctata</u>		
<u>Cymbella affinis</u>		
<u>Cymbella ventricosa</u>	17	101
<u>Gomphonema intricatum</u>	22	49
<u>Gomphonema olivacium</u>		
<u>Epithemia sorex</u>	4	39
<u>Nitzschia chasei</u>		
<u>Nitzschia dissipata</u>	1	
<u>Nitzschia frustulum</u>	99	118
<u>Nitzschia holsatica</u>	110	129
<u>Nitzschia latens</u>	20	347

Table 3-8-158. Algal taxa observed in the periphyton at the Yellow Creek Stations during RBOSP Aquatic Baseline Studies between October-November 1974 and August-September 1975.

CYANOPHYTA

Lyngbya spp.
Oscillatoria spp.
Schizothrix calcicola
Anabaena spp.
Plectonema spp.
Calothrix spp.
Rivularia spp.

CHLOROPHYTA

Ulothrix spp.
Cladophora spp.
Spirogyra spp.
Chlorophyta I

CHRYSTOPHYTA

Chrysophyta I
Cyclotella meneghiniana
Stephanodiscus tenuis
Diatoma tenue var. elongatum
Diatoma vulgare
Fragilaria pinnata
Fragilaria vaucheriae
Synedra amphicephala
Synedra minuscula
Synedra pulchella
Synedra pulchella var. lanceolata
Synedra tenera
Synedra ulna
Cocconeis pediculus
Cocconeis placentula
Achnanthes hauckiana
Achnanthes lanceolata
Achnanthes minutissima
Rhoicosphenia curvata
Mastogloia smithii
Gyrosigma acuminatum
Pleurosigma delicatulum
Navicula arvensis
Navicula capitata
Navicula cryptocephala
Navicula gregaria
Navicula minima

Table 3-8-158. Continued.

<u>Navicula</u>	<u>mutica</u>
<u>Navicula</u>	<u>pelliculosa</u>
<u>Navicula</u>	<u>pygmaea</u>
<u>Navicula</u>	<u>salinarum</u>
<u>Navicula</u>	<u>salinarum</u> var. <u>intermedia</u>
<u>Navicula</u>	<u>tantula</u>
<u>Navicula</u>	<u>tripunctata</u>
<u>Navicula</u>	<u>vaucheriae</u>
<u>Navicula</u>	<u>viridula</u>
<u>Navicula</u>	<u>spp.</u>
<u>Navicula</u>	<u>sp. 1</u>
<u>Navicula</u>	<u>sp. 2</u>
<u>Navicula</u>	<u>sp. 4</u>
<u>Caloneis</u>	<u>amphisbaena</u>
<u>Caloneis</u>	<u>bacillum</u>
<u>Pinnularia</u>	<u>brebissonii</u>
<u>Amphora</u>	<u>ovalis</u> var. <u>pediculus</u>
<u>Cymbella</u>	<u>affinis</u>
<u>Cymbella</u>	<u>cistula</u>
<u>Cymbella</u>	<u>delicatula</u>
<u>Cymbella</u>	<u>pusilla</u>
<u>Cymbella</u>	<u>sinuata</u>
<u>Cymbella</u>	<u>ventricosa</u>
<u>Gomphonema</u>	<u>gracile</u>
<u>Gomphonema</u>	<u>intricatum</u>
<u>Gomphonema</u>	<u>olivaceum</u>
<u>Gomphonema</u>	<u>parvulum</u>
<u>Gomphonema</u>	<u>ventricosum</u>
<u>Amphiprora</u>	<u>alata</u>
<u>Amphiprora</u>	<u>ornata</u>
<u>Epithemia</u>	<u>sorex</u>
<u>Epithemia</u>	<u>zebra</u>
<u>Rhopalodia</u>	<u>gibba</u>
<u>Rhopalodia</u>	<u>gibberula</u>
<u>Hantzschia</u>	<u>amphioxys</u>
<u>Nitzschia</u>	<u>acicularis</u>
<u>Nitzschia</u>	<u>amphibia</u>
<u>Nitzschia</u>	<u>apiculata</u>
<u>Nitzschia</u>	<u>capitellata</u>
<u>Nitzschia</u>	<u>denticula</u>
<u>Nitzschia</u>	<u>dissipata</u>
<u>Nitzschia</u>	<u>fonticola</u>
<u>Nitzschia</u>	<u>frustulum</u>
<u>Nitzschia</u>	<u>gracilis</u>
<u>Nitzschia</u>	<u>holsatica</u>
<u>Nitzschia</u>	<u>hungarica</u>
<u>Nitzschia</u>	<u>latens</u>

Table 3-8-158. Continued.

<u>Nitzschia</u>	<u>linearis</u>
<u>Nitzschia</u>	<u>microcephala</u>
<u>Nitzschia</u>	<u>palea</u>
<u>Nitzschia</u>	<u>sigmoidea</u>
<u>Nitzschia</u>	<u>vermicularis</u>
<u>Cymatopleura</u>	<u>solea</u>
<u>Surirella</u>	<u>ovata</u>
<u>Surirella</u>	<u>ovalis</u>

cyanophytes, Calothrix spp. and several diatoms, Navicula cryptocephala, Nitzschia frustulum, Navicula arvensis, Rhopalodia gibberula, and Surirella ovata.

Samples collected during May - June 1975 from Stations 20-22 had a moderate number of filamentous blue-green taxa present such as Lyngbya spp., Plectonema spp. and Calothrix spp. Achnanthes minutissima was the most abundant diatom from the periphyton community while Nitzschia frustulum was second in abundance. Station 19 had Achnanthes minutissima, Nitzschia denticula, Nitzschia frustulum, Navicula cryptocephala and Rhopalodia gibberula as the most abundant species present.

Each of the lower Yellow Creek stations had different major abundant species during the July - August 1975 sampling. At Station 19, Navicula cryptocephala and Nitzschia fonticola were most abundant. Station 20 had low algal densities and Navicula pelliculosa, Navicula cryptocephala and Nitzschia fonticola were most abundant. Lyngbya spp., Nitzschia fonticola, Achnanthes minutissima, and Amphora ovalis var. pediculus were most abundant at Station 21. Navicula pelliculosa was ten times more abundant than any other species at Station 22.

Achnanthes minutissima dominated at all the lower Yellow Creek stations in August - September 1975, ranging from 653 cells/mm² to 2,535 cells/mm². The next most abundant species was Nitzschia frustulum which ranged from 24 cells/mm² to 654 cells/mm².

The periphytic algae that colonized the artificial substrates at Stations 20 and 21 for May - June and July - August 1975 were dominated by Achnanthes minutissima and Nitzschia palea. Achnanthes minutissima, Nitzschia latens, Nitzschia holsatica, and Nitzschia frustulum were the most abundant species that occurred on the artificial substrates in August - September 1975.

d. White River - Densities of major algae observed from periphyton collections at White River stations (23-27) above the confluence with Yellow Creek from October 1974 to September 1975 are summarized in Tables 3-8-159

through 3-8-167. All the algal taxa observed from Stations 23-27 during the one year sampling period are listed in Table 3-8-168.

In October - November 1974, periphyton samples from the White River stations above the Yellow Creek confluence contained large populations of Epithemia sorex. The filamentous blue-green algae Calothrix spp. were abundant at most of these stations. Other subdominant taxa were Navicula salinarium var. intermedia, Navicula cryptocephala, Nitzschia frustulum, Nitzschia dissipata, and Lyngbya spp.

Epithemia sorex remained the most abundant species in the December 1974 - January 1975 samples from Stations 23-27. Other species that were abundant in the order of decreasing numbers were Diatoma vulgare, Nitzschia dissipata, Navicula cryptocephala, Lyngbya spp., Navicula salinarium var. intermedia and Cymbella affinis.

The periphyton community during the April 1975 collections had Navicula viridula, Navicula cryptocephala, Navicula tripunctata, Nitzschia dissipata, and Epithemia sorex with densities greater than 1,300 cells/mm².

The samples from May - June 1975 had different dominant species at each station. At Station 23, Amphora ovalis var. pediculus, Navicula cryptocephala, Epithemia sorex and Calothrix spp. were most abundant. Station 24 had Bicoeca lacustris, Amphora ovalis var. pediculus, and Calothrix spp. as abundant species. Total cell densities from Station 25 were low and the most abundant species were Plectonema spp. and Calothrix spp. Total cell densities were also low at Station 26 where the dominant, Amphora ovalis var. pediculus, had only 145 cells/mm². Station 27 had the highest cell densities of the stations above the Yellow Creek confluence. The dominant species were the small diatoms Navicula pelliculosa and Amphora ovalis var. pediculus.

Lyngbya spp. and Amphora ovalis var. pediculus were the most abundant components of the July - August 1975 periphyton samples from Stations 23-27.

Table 3-8-159. Mean densities of the major algal taxa observed in the periphyton at the White River Stations during RBOSP Aquatic Baseline Studies, October - November 1974.
(Data are expressed as cells/mm² except that data for filamentous forms are expressed as the number of 50 μ units.)

Above Confluence with Yellow Creek					
	Station				
	<u>23</u>	<u>24</u>	<u>25</u>	<u>26</u>	<u>27</u>
CYANOPHYTA					
<u>Lyngbya</u> spp.	416		1181	416	596
<u>Oscillatoria</u> spp.					
<u>Plectonema</u> spp.					
<u>Calothrix</u> spp.	113	3476	8696	855	1103
CHLOROPHYTA					
<u>Ulothrix</u> spp.					
CHRYSTOPHYTA					
<u>Cyclotella meneghiniana</u>					
<u>Diatoma vulgare</u>	326	23	90	169	79
<u>Meridion circulare</u>					
<u>Fragilaria vaucheriae</u>					
<u>Synedra amphicephala</u>					
<u>Synedra ulna</u>	821	136	90	248	34
<u>Achnanthes lanceolata</u>					
<u>Achnanthes minutissima</u>	56	135	56	135	34
<u>Pleurosigma delicatulum</u>					
<u>Navicula cryptocephala</u>	1060	484	270	630	259
<u>Navicula pelliculosa</u>					
<u>Navicula salinarum</u> var. <u>intermedia</u>	1024	788	867	990	315

Table 3-8-159. Continued.

	Station				
	23	24	25	26	27
<u>Navicula tripunctata</u>	90	304	146	146	113
<u>Navicula sp. 1</u>					
<u>Cymbella affinis</u>	383	146	79	79	45
<u>Cymbella pusilla</u>					
<u>Gomphonema angustatum</u>					
<u>Gomphonema intricatum</u>					
<u>Gomphonema olivaceum</u>	259	349	259	315	90
<u>Gomphonema ventricosum</u>	135	23	124	113	79
<u>Epithemia sorex</u>	5411	8651	11475	8584	7279
<u>Rhopalodia gibberula</u>					
<u>Nitzschia dissipata</u>	293	326	551	383	146
<u>Nitzschia frustulum</u>	630	371	450	473	90
<u>Nitzschia linearis</u>					
<u>Nitzschia palea</u>					

Table 3-8-159. Continued.

	At Confluence with Yellow Creek	
	Station	
	28	29
CYANOPHYTA		
<u>Lyngbya</u> spp.		1170
<u>Oscillatoria</u> spp.		799
<u>Plectonema</u> spp.		
<u>Calothrix</u> spp.	653	
CHLOROPHYTA		
<u>Ulothrix</u> spp.		
CHRYSTOPHYTA		
<u>Cyclotella meneghiniana</u>		
<u>Diatoma vulgare</u>	158	68
<u>Meridion circulare</u>		
<u>Fragilaria vaucheriae</u>		
<u>Synedra amphicephala</u>		
<u>Synedra ulna</u>	258	23
<u>Achnanthes lanceolata</u>		
<u>Achnanthes minutissima</u>	180	956
<u>Pleurosigma delicatulum</u>		
<u>Navicula cryptocephala</u>	338	889
<u>Navicula pelliculosa</u>		
<u>Navicula salinarum</u> var. <u>intermedia</u>	2419	338

Table 3-8-159. Continued.

	Station	
	28	29
<u>Navicula tripunctata</u>	124	102
<u>Navicula sp. 1</u>		
<u>Cymbella affinis</u>	124	371
<u>Cymbella pusilla</u>		
<u>Gomphonema angustatum</u>		
<u>Gomphonema intricatum</u>		
<u>Gomphonema olivaceum</u>	428	158
<u>Gomphonema ventricosum</u>		
<u>Epithemia sorex</u>	5096	2486
<u>Rhopalodia gibberula</u>		
<u>Nitzschia dissipata</u>	450	371
<u>Nitzschia frustulum</u>	416	382
<u>Nitzschia linearis</u>		
<u>Nitzschia palea</u>	68	113

Table 3-8-159. Continued.

	Below Confluence with Yellow Creek					
	Station					
	<u>30</u>	<u>31</u>	<u>32</u>	<u>33</u>	<u>34</u>	<u>35</u>
CYANOPHYTA						
<u>Lyngbya</u> spp.	911			1091		
<u>Oscillatoria</u> spp.						
<u>Plectonema</u> spp.						
<u>Calothrix</u> spp.	1058	2149	484	1834	6705	2554
CHLOROPHYTA						
<u>Ulothrix</u> spp.						
CHRYSTOPHYTA						
<u>Cyclotella meneghiniana</u>						
<u>Diatoma vulgare</u>	23	270	428	1564	293	371
<u>Meridion circulare</u>						
<u>Fragilaria vaucheriae</u>						
<u>Synedra amphicephala</u>						
<u>Synedra ulna</u>	195	394	34	203	463	45
<u>Achnanthes lanceolata</u>						
<u>Achnanthes minutissima</u>	79	248	563	248	394	180
<u>Pleurosigma delicatulum</u>						
<u>Navicula cryptocephala</u>	259	574	1193	293	180	799
<u>Navicula pelliculosa</u>						
<u>Navicula salinarum</u> var. <u>intermedia</u>	1271	1001	2520	798	236	360

Table 3-8-159. Continued.

	Station					
	30	31	32	33	34	35
<u>Navicula tripunctata</u>	124	169	473	56	34	236
<u>Navicula sp. 1</u>						
<u>Cymbella affinis</u>	34	428	1058	1881	203	371
<u>Cymbella pusilla</u>						
<u>Gomphonema angustatum</u>						
<u>Gomphonema intricatum</u>		124	191	383	45	113
<u>Gomphonema olivaceum</u>	135	326	821	563	326	315
<u>Gomphonema ventricosum</u>	56	214	450	394	79	79
<u>Epithemia sorex</u>	9439	10035	5501	5355	2621	4568
<u>Rhopalodia gibberula</u>						
<u>Nitzschia dissipata</u>	439	630	1609	304	90	304
<u>Nitzschia frustulum</u>	259	259	1181	956	326	416
<u>Nitzschia linearis</u>						
<u>Nitzschia palea</u>						

Table 3-8-160. Mean densities of the major algal taxa observed in the periphyton at the White River Stations during RBOSP Aquatic Baseline Studies, December 1974 - January 1975. (Data are expressed as cells/mm² except that data for filamentous forms are expressed as the number of 50 μ units.)

	Above Confluence with Yellow Creek				
	Station				
	<u>23</u>	<u>24</u>	<u>25</u>	<u>26</u>	<u>27</u>
CYANOPHYTA					
<u>Lyngbya</u> spp.	1185	1440	933	1069	428
<u>Calothrix</u> spp.	293	1091	270	619	1148
CHLOROPHYTA					
<u>Zygnema</u> spp.					
CHRYSTOPHYTA					
<u>Diatoma</u> <u>hiemale</u>					
<u>Diatoma</u> <u>vulgare</u>	1643	2576	8799	3476	1170
<u>Meridion</u> <u>circularae</u>					
<u>Fragilaria</u> <u>vaucheriae</u>					
<u>Synedra</u> <u>amphicephala</u>					
<u>Synedra</u> <u>ulna</u>	192	945	340	2284	315
<u>Cocconeis</u> <u>pediculus</u>					
<u>Achnanthes</u> <u>lanceolata</u>					
<u>Achnanthes</u> <u>minutissima</u>	399	203	666	101	293
<u>Navicula</u> <u>arvensis</u>					
<u>Navicula</u> <u>cryptocephala</u>	797	1958	1071	1676	1136
<u>Navicula</u> <u>minima</u>					

Table 3-8-160. Continued.

	Station				
	<u>23</u>	<u>24</u>	<u>25</u>	<u>26</u>	<u>27</u>
CHRYSTOPHYTA (Cont.)					
<u>Navicula pelliculosa</u>					
<u>Navicula salinarum</u> var. <u>intermedia</u>	718	1204	519	1721	630
<u>Navicula tripunctata</u>	79	192	425	360	203
<u>Navicula viridula</u>					
<u>Amphora ovalis</u>					
<u>Amphora ovalis</u> var. <u>pediculus</u>	90	248	63	113	900
<u>Cymbella affinis</u>	626	1294	880	1451	315
<u>Gomphonema intricatum</u>					
<u>Gomphonema olivaceum</u>	273	349	758	495	338
<u>Gomphonema ventricosum</u>	225	214	205	394	52
<u>Epithemia sorex</u>	8241	8370	4894	5974	7335
<u>Nitzschia apiculata</u>					
<u>Nitzschia baccata</u>					
<u>Nitzschia denticula</u>					
<u>Nitzschia dissipata</u>	684	1755	1178	2486	855
<u>Nitzschia frustulum</u>	281	1381	293	946	686
<u>Nitzschia linearis</u>					
<u>Nitzschia palea</u>					
<u>Surirella ovata</u>					

Table 3-8-160. Continued.

At Confluence with Yellow Creek	Station	
	<u>28</u>	<u>29</u>
CYANOPHYTA		
<u>Lyngbya</u> spp.	416	1592
<u>Calothrix</u> spp.		118
CHLOROPHYTA		
<u>Zygnema</u> spp.		
CHRYSTOPHYTA		
<u>Diatoma</u> <u>hiemale</u>		
<u>Diatoma</u> <u>vulgare</u>	303	326
<u>Meridion</u> <u>circulare</u>		85
<u>Fragilaria</u> <u>vaucheriae</u>		
<u>Synedra</u> <u>amphicephala</u>		
<u>Synedra</u> <u>ulna</u>		
<u>Cocconeis</u> <u>pediculus</u>		
<u>Achnanthes</u> <u>lanceolata</u>	394	3617
<u>Achnanthes</u> <u>minutissima</u>		
<u>Navicula</u> <u>arvensis</u>	146	495
<u>Navicula</u> <u>cryptocephala</u>		
<u>Navicula</u> <u>minima</u>		

Table 3-8-160. Continued.

	Station	
	28	29
CHRYSTOPHYTA (Cont.)		
<u>Navicula pelliculosa</u>		
<u>Navicula salinarum</u> var. <u>intermedia</u>	101	163
<u>Navicula tripunctata</u>		1524
<u>Navicula viridula</u>		
<u>Amphora ovalis</u>	90	11
<u>Amphora ovalis</u> var. <u>pediculus</u>		
<u>Cymbella affinis</u>	236	873
<u>Gomphonema intricatum</u>	68	248
<u>Gomphonema olivaceum</u>	124	51
<u>Gomphonema ventricosum</u>		
<u>Epithemia sorex</u>	1327	1335
<u>Nitzschia apiculata</u>		
<u>Nitzschia baccata</u>		
<u>Nitzschia denticula</u>		
<u>Nitzschia dissipata</u>		1058
<u>Nitzschia frustulum</u>	112	360
<u>Nitzschia linearis</u>		
<u>Nitzschia palea</u>		
<u>Surirella ovata</u>		

Table 3-8-160. Continued.

	Below Confluence with Yellow Creek		Station			
	<u>30</u>	<u>31</u>	<u>32</u>	<u>33</u>	<u>34</u>	<u>35</u>
CYANOPHYTA						
<u>Lyngbya</u> spp.	619	2644	2085	1575	4624	6986
<u>Calothrix</u> spp.	1159	878	945	728	203	371
CHLOROPHYTA						
<u>Zygnema</u> spp.						
CHRY SOPHYTA						
<u>Diatoma hiemale</u>						
<u>Diatoma vulgare</u>	1620	1249	798	1845	664	1058
<u>Meridion circulare</u>						
<u>Fragilaria vaucheriae</u>						
<u>Synedra amphicephala</u>						
<u>Synedra ulna</u>	461	169	3	652	68	28
<u>Cocconeis pediculus</u>	90	338	11	113	113	23
<u>Achnanthes lanceolata</u>						
<u>Achnanthes minutissima</u>	68	889	1116	281	90	203
<u>Navicula arvensis</u>						
<u>Navicula cryptocephala</u>	1373	191	495	1215	518	450
<u>Navicula minima</u>						

Table 3-8-160. Continued.

	Station					
	<u>30</u>	<u>31</u>	<u>32</u>	<u>33</u>	<u>34</u>	<u>35</u>
CHRYSTOPHYTA (Cont.)						
<u>Navicula pelliculosa</u>						
<u>Navicula salinarum</u> var. <u>intermedia</u>	630	394	128	900	135	180
<u>Navicula tripunctata</u>	281	203	128	203	45	124
<u>Navicula viridula</u>						
<u>Amphora ovalis</u>						
<u>Amphora ovalis</u> var. <u>pediculus</u>						
<u>Cymbella affinis</u>	630	563	506	866	338	281
<u>Gomphonema intricatum</u>	56	11	325	79	135	169
<u>Gomphonema olivaceum</u>	281	271	65	360	124	34
<u>Gomphonema ventricosum</u>						
<u>Epithemia sorex</u>	5141	3386	2489	5299	4309	2171
<u>Nitzschia apiculata</u>						
<u>Nitzschia baccata</u>						
<u>Nitzschia denticula</u>						
<u>Nitzschia dissipata</u>	1384	1755	279	2138	394	642
<u>Nitzschia frustulum</u>	889	585	301	776	360	338
<u>Nitzschia linearis</u>						
<u>Nitzschia palea</u>						
<u>Surirella ovata</u>						

Table 3-8-161. Mean densities of the major algal taxa observed in the periphyton at the White River Stations during RBOSP Aquatic Baseline Studies, April 1975. (Data are expressed as cells/mm² except that data for filamentous forms are expressed as the number of 50 μ units.)

	Above Confluence with Yellow Creek		Station		
	<u>23</u>	<u>24</u>	<u>25</u>	<u>26</u>	<u>27</u>
CYANOPHYTA					
<u>Lyngbya</u> spp.	101	562	90	202	146
<u>Plectonema</u> spp.					
<u>Calothrix</u> spp.	911	236	585	191	124
CHLOROPHYTA					
<u>Ulothrix</u> spp.					
CHRYSTOPHYTA					
<u>Meridion</u> <u>circulare</u>					
<u>Fragilaria</u> <u>vaucheriae</u>					
<u>Synedra</u> <u>amphicephala</u>					
<u>Achnanthes</u> <u>lanceolata</u>					
<u>Achnanthes</u> <u>minutissima</u>	990	202	157	84	202
<u>Navicula</u> <u>arvensis</u>	2396	1384	2498	1744	2329
<u>Navicula</u> <u>cryptocephala</u>					
<u>Navicula</u> <u>pelliculosa</u>					
<u>Navicula</u> <u>salinarum</u> var. <u>intermedia</u>	112	34	79	129	236
<u>Navicula</u> <u>tripunctata</u>	1530	742	4286	1176	1463
<u>Navicula</u> <u>viridula</u>	3487	2070	3420	2458	2767
<u>Navicula</u> sp. 1					
<u>Navicula</u> sp. 2					
<u>Amphora</u> <u>ovalis</u> var. <u>pediculus</u>	225	405	293	535	360
<u>Cymbella</u> <u>affinis</u>	315	540	360	163	236

Table 3-8-161. Continued.

	Station				
	<u>23</u>	<u>24</u>	<u>25</u>	<u>26</u>	<u>27</u>
CHRYSTOPHYTA (Cont.)					
<u>Cymbella ventricosa</u>					
<u>Gomphonema intricatum</u>					
<u>Gomphonema olivaceum</u>	371	742	416	292	675
<u>Epithemia sorex</u>	1395	585	1778	2228	911
<u>Rhopalodia gibberula</u>					
<u>Nitzschia chasei</u>	135	11	169	101	180
<u>Nitzschia denticula</u>		1			
<u>Nitzschia dissipata</u>	1395	945	1563	1694	1957
<u>Nitzschia frustulum</u>	339	112	180	158	169
<u>Nitzschia linearis</u>					
<u>Nitzschia palea</u>					
<u>Surirella ovata</u>	439	34	90	34	540

Table 3-8-161. Continued.

At Confluence with Yellow Creek	Station	
	28	29
CYANOPHYTA		
<u>Lyngbya</u> spp.	157	259
<u>Plectonema</u> spp.	101	1024
<u>Calothrix</u> spp.	45	979
CHLOROPHYTA		
<u>Ulothrix</u> spp.		
CHRYSTOPHYTA		
<u>Meridion</u> <u>circulare</u>		
<u>Fragilaria</u> <u>vaucheriae</u>		
<u>Synedra</u> <u>amphicephala</u>		
<u>Achnanthes</u> <u>lanceolata</u>		
<u>Achnanthes</u> <u>minutissima</u>	40	731
<u>Navicula</u> <u>arvensis</u>		
<u>Navicula</u> <u>cryptocephala</u>	1800	889
<u>Navicula</u> <u>pelliculosa</u>		
<u>Navicula</u> <u>salinarum</u> var. <u>intermedia</u>	467	292
<u>Navicula</u> <u>tripunctata</u>	3161	1204
<u>Navicula</u> <u>viridula</u>		
<u>Navicula</u> sp. 1		
<u>Navicula</u> sp. 2		
<u>Amphora</u> <u>ovalis</u> var. <u>pediculus</u>	169	79
<u>Cymbella</u> <u>affinis</u>	225	247

Table 3-8-161. Continued.

	Station	
	<u>28</u>	<u>29</u>
CHRYSOPHYTA (Cont.)		
<u>Cymbella ventricosa</u>		
<u>Gomphonema intricatum</u>		
<u>Gomphonema olivaceum</u>	1710	574
<u>Epithemia sorex</u>	124	1192
<u>Rhopalodia gibberula</u>		
<u>Nitzschia chasei</u>	101	112
<u>Nitzschia denticula</u>	1	
<u>Nitzschia dissipata</u>	1957	1474
<u>Nitzschia frustulum</u>	174	101
<u>Nitzschia linearis</u>		
<u>Nitzschia palea</u>		
<u>Surirella ovata</u>	298	124

Table 3-8-161. Continued.

Below Confluence with Yellow Creek						
	Station					
	30	31	32	33	34	35
CYANOPHYTA						
<u>Lyngbya</u> spp.	45	619	383	191	34	180
<u>Plectonema</u> spp.						
<u>Calothrix</u> spp.	461	698	221	101	276	473
CHLOROPHYTA						
<u>Ulothrix</u> spp.						
CHRYSTOPHYTA						
<u>Meridion</u> <u>circulare</u>						
<u>Fragilaria</u> <u>vaucheriae</u>						
<u>Synedra</u> <u>amphicephala</u>						
<u>Achnanthes</u> <u>lanceolata</u>	34	79	38	45	70	79
<u>Achnanthes</u> <u>minutissima</u>						
<u>Navicula</u> <u>arvensis</u>	1575	765	1016	1682	408	3229
<u>Navicula</u> <u>cryptocephala</u>						
<u>Navicula</u> <u>pelliculosa</u>						
<u>Navicula</u> <u>salinarum</u> var. <u>intermedia</u>	1710	540	615	585	281	1226
<u>Navicula</u> <u>tripunctata</u>	1913	776	1001	1822	695	2734
<u>Navicula</u> <u>viridula</u>						
<u>Navicula</u> sp. 1						
<u>Navicula</u> sp. 2	776	146	34	382	87	618
<u>Amphora</u> <u>ovalis</u> var. <u>pediculus</u>	146	113	367	347	104	653
<u>Cymbella</u> <u>affinis</u>						

Table 3-8-161. Continued.

	Station					
	<u>30</u>	<u>31</u>	<u>32</u>	<u>33</u>	<u>34</u>	<u>35</u>
CHRYSTOPHYTA (Cont.)						
<u>Cymbella ventricosa</u>	124	11	34	90	45	113
<u>Gomphonema intricatum</u>						
<u>Gomphonema olivaceum</u>	236	191	259	663	613	1384
<u>Epithemia sorex</u>	2171	3611	2224	438	174	450
<u>Rhopalodia gibberula</u>						
<u>Nitzschia chasei</u>	247	124	11	45		23
<u>Nitzschia denticula</u>						
<u>Nitzschia dissipata</u>	1282	1496	889	1328	320	1069
<u>Nitzschia frustulum</u>	293	56		45	186	79
<u>Nitzschia linearis</u>						
<u>Nitzschia palea</u>						
<u>Surirella ovata</u>	180	11	45	57	39	79

Table 3-8-162. Mean densities of the major algal taxa observed in the periphyton at the White River Stations during RBOSP Aquatic Baseline Studies, May - June 1975. (Data are expressed as cells/mm² except that data for filamentous forms are expressed as the number of 50 μ units.)

	Above Confluence with Yellow Creek				
	23	24	25	26	27
CYANOPHYTA					
<u>Lyngbya</u> spp.	388	161	2	2	23
<u>Schizothrix</u> spp.	180				
<u>Plectonema</u> spp.			263	2	11
<u>Calothrix</u> spp.	495	657	217		
CHLOROPHYTA					
<u>Cladophora</u> spp.					
CHRYSOPHYTA					
<u>Bicoeca lacustris</u>		1116			
<u>Cyclotella meneghiniana</u>					
<u>Fragilaria vaucheriae</u>					
<u>Synedra amphicephala</u>					
<u>Synedra pulchella</u>					
<u>Synedra ulna</u>					
<u>Achnanthes lanceolata</u>	17	30	10	9	306
<u>Achnanthes minutissima</u>					
<u>Navicula arvensis</u>	917	416	150	81	121
<u>Navicula cryptocephala</u>					
<u>Navicula minima</u>					

Table 3-8-162. Continued.

	Station				
	23	24	25	26	27
CHRYSTOPHYTA (Cont.)					
<u>Navicula pelliculosa</u>	11	5	19	61	2090
<u>Navicula tripunctata</u>	337	395	20	3	2
<u>Navicula vaucheriae</u>				1	252
<u>Navicula viridula</u>					
<u>Navicula sp. 1</u>					
<u>Navicula sp. 2</u>					
<u>Navicula sp. 5</u>					
<u>Amphora ovalis var. pediculus</u>	1114	1071	83	145	1914
<u>Cymbella affinis</u>					
<u>Cymbella microcephala</u>	11	28	9	49	576
<u>Cymbella sinuata</u>					
<u>Cymbella ventricosa</u>					
<u>Gomphonema intricatum</u>	658	343	23		
<u>Epithemia sorex</u>					
<u>Rhopalodia gibberula</u>					
<u>Nitzschia chasei</u>					
<u>Nitzschia denticula</u>	202	233	16	53	50
<u>Nitzschia dissipata</u>	96	313	84	46	263
<u>Nitzschia frustulum</u>					
<u>Nitzschia linearis</u>					
<u>Nitzschia microcephala</u>					
<u>Nitzschia palea</u>					

Table 3-8-162. Continued.

At Confluence with Yellow Creek		
	Station	
	<u>28</u>	<u>29</u>
CYANOPHYTA		
<u>Lyngbya</u> spp.	108	29
<u>Schizothrix</u> spp.		
<u>Plectonema</u> spp.		
<u>Calothrix</u> spp.	365	36
CHLOROPHYTA		
<u>Cladophora</u> spp.		
CHRYSTOPHYTA		
<u>Bicoeca lacustris</u>	13	40
<u>Cyclotella meneghiniana</u>		
<u>Fragilaria vaucheriae</u>		
<u>Synedra amphicephala</u>		
<u>Synedra pulchella</u>		
<u>Synedra ulna</u>		
<u>Achnanthes lanceolata</u>	171	27
<u>Achnanthes minutissima</u>		
<u>Navicula arvensis</u>	355	128
<u>Navicula cryptocephala</u>		
<u>Navicula minima</u>		

Table 3-8-162. Continued.

	Station	
	28	29
CHRYSTOPHYTA (Cont.)		
<u>Navicula pelliculosa</u>	117	61
<u>Navicula tripunctata</u>	108	32
<u>Navicula vaucheriae</u>		
<u>Navicula viridula</u>	68	20
<u>Navicula sp. 1</u>		
<u>Navicula sp. 2</u>		
<u>Navicula sp. 5</u>		
<u>Amphora ovalis var. pediculus</u>	265	400
<u>Cymbella affinis</u>		
<u>Cymbella microcephala</u>		
<u>Cymbella sinuata</u>	202	166
<u>Cymbella ventricosa</u>	54	5
<u>Gomphonema intricatum</u>		
<u>Epithemia sorex</u>	351	16
<u>Rhopalodia gibberula</u>		
<u>Nitzschia chasei</u>		
<u>Nitzschia denticula</u>		
<u>Nitzschia dissipata</u>	113	29
<u>Nitzschia frustulum</u>	257	488
<u>Nitzschia linearis</u>		
<u>Nitzschia microcephala</u>		
<u>Nitzschia palea</u>	49	11

Table 3-8-162. Continued.

Below Confluence with Yellow Creek		Station					
		30	31	32	33	34	35
CYANOPHYTA							
	<u>Lyngbya</u> spp.	425	99	62	153	50	
	<u>Schizothrix</u> spp.						
	<u>Plectonema</u> spp.	63	9				
	<u>Calothrix</u> spp.	16	16	143	144	156	
CHLOROPHYTA							
	<u>Cladophora</u> spp.						
CHRYSTOPHYTA							
	<u>Bicoeca lacustris</u>						
	<u>Cyclotella meneghiniana</u>						
	<u>Fragilaria vaucheriae</u>						
	<u>Synedra amphicephala</u>						
	<u>Synedra pulchella</u>						
	<u>Synedra ulna</u>						
	<u>Achnanthes lanceolata</u>						
	<u>Achnanthes minutissima</u>	8	6	29	13	7	8
	<u>Navicula arvensis</u>	52	42	143	139	126	39
	<u>Navicula cryptocephala</u>	47		49	122	63	
	<u>Navicula minima</u>						

Table 3-8-162. Continued.

	Station					
	30	31	32	33	34	35
CHRYSOPHYTA (Cont.)						
<u>Navicula pelliculosa</u>	32	1	9	22	18	15
<u>Navicula tripunctata</u>	15	2	92	175	48	12
<u>Navicula vaucheriae</u>						
<u>Navicula viridula</u>	16	6	17	27	13	4
<u>Navicula sp. 1</u>						
<u>Navicula sp. 2</u>						
<u>Navicula sp. 5</u>						
<u>Amphora ovalis var. pediculus</u>	636	122	1845	1998	2559	122
<u>Cymbella affinis</u>						
<u>Cymbella microcephala</u>						
<u>Cymbella sinuata</u>	14	1	128	99	41	27
<u>Cymbella ventricosa</u>						
<u>Gomphonema intricatum</u>	13	2	62	27	57	
<u>Epithemia sorex</u>						
<u>Rhopalodia gibberula</u>	10		139	63	76	
<u>Nitzschia chasei</u>						
<u>Nitzschia denticula</u>	6	9	91	54	66	11
<u>Nitzschia dissipata</u>	563	96	2623	166	273	28
<u>Nitzschia frustulum</u>						
<u>Nitzschia linearis</u>						
<u>Nitzschia microcephala</u>						
<u>Nitzschia palea</u>						

Table 3-8-163. Mean densities of the major algal taxa observed in the periphyton at the White River Stations during RBOSP Aquatic Baseline Studies, July - August 1975. (Data are expressed as cells/mm² except that data for filamentous forms are expressed as the number of 50 μ units.)

	Above Confluence with Yellow Creek				
	Station				
	<u>23</u>	<u>24</u>	<u>25</u>	<u>26</u>	<u>27</u>
CYANOPHYTA					
<u>Lyngbya</u> spp.	2347	1575	881	1892	2208
<u>Plectonema</u> spp.		248	110	112	30
<u>Calothrix</u> spp.					
CHRYSTOPHYTA					
<u>Bicoeca lacustris</u>		323	308	577	233
<u>Diatoma vulgare</u>					
<u>Fragilaria vaucheriae</u>					
<u>Synedra amphicephala</u>					
<u>Synedra famelica</u>					
<u>Synedra minuscula</u>					
<u>Synedra ulna</u>	360	53	407	255	502
<u>Cocconeis placentula</u>					
<u>Achnanthes lanceolata</u>					
<u>Achnanthes minutissima</u>					
<u>Navicula arvensis</u>	397	892	217	741	907
<u>Navicula cryptocephala</u>					
<u>Navicula pelliculosa</u>					
<u>Navicula salinarum</u> var. <u>intermedia</u>					
<u>Navicula tripunctata</u>	150	375	43	285	217
<u>Navicula vaucheriae</u>					
<u>Navicula viridula</u>	188	165	34	75	120
<u>Navicula</u> sp. 1					
<u>Navicula</u> sp. 2					

Table 3-8-163. Continued.

	Station				
	<u>23</u>	<u>24</u>	<u>25</u>	<u>26</u>	<u>27</u>
CHRYSTOPHYTA (Cont.)					
<u>Amphora ovalis</u> var. <u>pediculus</u>	705	1402	318	2338	413
<u>Cymbella affinis</u>	60	15	12	728	52
<u>Cymbella sinuata</u>					
<u>Cymbella ventricosa</u>					
<u>Gomphonema intricatum</u>					
<u>Gomphonema olivaceum</u>	292	187	69	158	217
<u>Epithemia sorex</u>	7	255	11	159	60
<u>Nitzschia acicularis</u>					
<u>Nitzschia capitellata</u>					
<u>Nitzschia chasei</u>	22	143	12	114	142
<u>Nitzschia denticula</u>					
<u>Nitzschia dissipata</u>	337	240	36	150	232
<u>Nitzschia fonticola</u>					
<u>Nitzschia frustulum</u>	195	165	44	302	157
<u>Nitzschia holsatica</u>	247	233	14	216	352
<u>Nitzschia linearis</u>					
<u>Nitzschia palea</u>					

Table 3-8-163. Continued.

	At Confluence with Yellow Creek	
	Station	
	28	29
CYANOPHYTA		
<u>Lyngbya</u> spp.	1537	5160
<u>Plectonema</u> spp.		
<u>Calothrix</u> spp.		
CHRYSTOPHYTA		
<u>Bicoeca lacustris</u>	67	120
<u>Diatoma vulgare</u>		
<u>Fragilaria vaucheriae</u>	19	143
<u>Synedra amphicephala</u>		
<u>Synedra famelica</u>		
<u>Synedra minuscula</u>		
<u>Synedra ulna</u>	165	480
<u>Cocconeis placentula</u>		
<u>Achnanthes lanceolata</u>		
<u>Achnanthes minutissima</u>	30	135
<u>Navicula arvensis</u>		
<u>Navicula cryptocephala</u>	486	398
<u>Navicula pelliculosa</u>		
<u>Navicula salinarum</u> var. <u>intermedia</u>	180	68
<u>Navicula tripunctata</u>	173	22
<u>Navicula vaucheriae</u>		
<u>Navicula viridula</u>	191	90
<u>Navicula</u> sp. 1		
<u>Navicula</u> sp. 2		

Table 3-8-163. Continued.

	Station	
	<u>28</u>	<u>29</u>
CHRYSTOPHYTA (Cont.)		
<u>Amphora ovalis</u> var. <u>pediculus</u>	1117	2129
<u>Cymbella affinis</u>		
<u>Cymbella sinuata</u>	52	307
<u>Cymbella ventricosa</u>		
<u>Gomphonema intricatum</u>		
<u>Gomphonema olivaceum</u>	270	420
<u>Epithemia sorex</u>		
<u>Nitzschia acicularis</u>		
<u>Nitzschia capitellata</u>		
<u>Nitzschia chasei</u>		
<u>Nitzschia denticula</u>		
<u>Nitzschia dissipata</u>	345	328
<u>Nitzschia fonticola</u>		
<u>Nitzschia frustulum</u>	79	120
<u>Nitzschia holsatica</u>	161	240
<u>Nitzschia linearis</u>		
<u>Nitzschia palea</u>		

Table 3-8-163. Continued.

Below Confluence with Yellow Creek Station						
	<u>30</u>	<u>31</u>	<u>32</u>	<u>33</u>	<u>34</u>	<u>35</u>
CYANOPHYTA						
<u>Lyngbya</u> spp.	2895	3704	2841	192	1203	3652
<u>Plectonema</u> spp.						
<u>Calothrix</u> spp.	428	302	124	7	145	307
CHRYSTOPHYTA						
<u>Bicoeca lacustris</u>	400		529			360
<u>Diatoma vulgare</u>	23	84	292	10	15	307
<u>Fragilaria vaucheriae</u>						
<u>Synedra amphicephala</u>						
<u>Synedra famelica</u>						
<u>Synedra minuscula</u>						
<u>Synedra ulna</u>	202	581	1687	159	175	742
<u>Cocconeis placentula</u>						
<u>Achnanthes lanceolata</u>						
<u>Achnanthes minutissima</u>						
<u>Navicula arvensis</u>						
<u>Navicula cryptocephala</u>	900	628	787	311	422	1196
<u>Navicula pelliculosa</u>						
<u>Navicula salinarum</u> var. <u>intermedia</u>	98	97	169	60	87	176
<u>Navicula tripunctata</u>	128	113	371	79	44	416
<u>Navicula vaucheriae</u>						
<u>Navicula viridula</u>	52	88	293	38	105	247
<u>Navicula</u> sp. 1						
<u>Navicula</u> sp. 2						

Table 3-8-163. Continued.

	Station					
	<u>30</u>	<u>31</u>	<u>32</u>	<u>33</u>	<u>34</u>	<u>35</u>
CHRYSTOPHYTA (Cont.)						
<u>Amphora ovalis</u> var. <u>pediculus</u>	1846	416	563	616	300	1582
<u>Cymbella affinis</u>						
<u>Cymbella sinuata</u>						
<u>Cymbella ventricosa</u>						
<u>Gomphonema intricatum</u>						
<u>Gomphonema olivaceum</u>	323	645	304	322	100	641
<u>Epithemia sorex</u>						
<u>Nitzschia acicularis</u>						
<u>Nitzschia capitellata</u>						
<u>Nitzschia chasei</u>						
<u>Nitzschia denticula</u>						
<u>Nitzschia dissipata</u>	247	188	754	292	219	1042
<u>Nitzschia fonticola</u>						
<u>Nitzschia frustulum</u>	105	43	337	41	19	390
<u>Nitzschia holsatica</u>	120	146	472	197	150	677
<u>Nitzschia linearis</u>						
<u>Nitzschia palea</u>						

Table 3-8-164. Mean densities of the major algal taxa observed in the periphyton at the White River Stations during RBOSP Aquatic Baseline Studies, August - September 1975. (Data are expressed as the cells/mm² except that data for filamentous forms are expressed as the number of 50μ units.)

	Above Confluence with Yellow Creek				
	23	24	25	26	27
CYANOPHYTA					
<u>Lyngbya</u> spp.	956	1125	1732	281	697
CHRYSTOPHYTA					
<u>Diatoma</u> <u>vulgare</u>	45	45	67	112	765
<u>Navicula</u> <u>cryptocephala</u>	798	1665	360	2294	2182
<u>Navicula</u> <u>salinarium</u> v. <u>intermedia</u>	989	900	652	2193	1327
<u>Navicula</u> <u>tripunctata</u>	101	494	22	585	585
<u>Amphora</u> <u>ovalis</u> v. <u>pediculus</u>	67	2970	79	967	2542
<u>Cymbella</u> <u>affinis</u>	191	337	416	270	405
<u>Gomphonema</u> <u>olivaceum</u>	259	225	34	56	225
<u>Gomphonema</u> <u>ventricosa</u>	236	68	236	337	1148
<u>Epithemia</u> <u>sorex</u>	29981	18029	27461	14366	10440
<u>Rhopolodia</u> <u>gibba</u>	180	180	3	257	112
<u>Nitzschia</u> <u>chasei</u>	68	1080	168	1091	877
<u>Nitzschia</u> <u>dissipata</u>	1833	2947	967	2723	2700
<u>Nitzschia</u> <u>frustulum</u>	1507	1012	955	664	2115
<u>Nitzschia</u> <u>palea</u>	34	90	269	315	585

Table 3-8-164. Continued.

	At Confluence with Yellow Creek		Station
		<u>28</u>	<u>29</u>
CYANOPHYTA			
<u>Lyngbya</u> spp.		2404	795
<u>Calothrix</u> spp.		26	
CHRYSTOPHYTA			
<u>Bicoeca lacustris</u>		221	
<u>Navicula cryptocephala</u>		277	476
<u>Navicula salinarum</u> var. <u>intermedia</u>		623	712
<u>Navicula viridula</u>		45	
<u>Navicula tantula</u>		111	
<u>Navicula tripunctata</u>		75	127
<u>Amphora ovalis</u> v. <u>pediculus</u>		683	158
<u>Cymbella ventricosa</u>		41	
<u>Gomphonema olivaceum</u>		67	
<u>Epithemia sores</u>		1117	13973
<u>Nitzschia dissipata</u>		707	739
<u>Nitzschia frustulum</u>		392	409
<u>Nitzschia chasei</u>		37	

Table 3-8-164. Continued.

	Below Confluence with Yellow Creek		Station			
	<u>30</u>	<u>31</u>	<u>32</u>	<u>33</u>	<u>34</u>	<u>35</u>
CYANOPHYTA						
<u>Lyngbya</u> spp.	528	709	360	1,125	291	292
CHRY SOPHYTA						
<u>Synedra delicatissima</u>	213	386	1,270	45	14	11
<u>Diatoma vulgare</u>	168	532	1,170	180	6	45
<u>Navicula cryptocephala</u>	528	749	1,193	517	201	787
<u>Navicula salinarum</u> var. <u>intermedia</u>	1,158	990	3,263	900	197	1,181
<u>Navicula tantula</u>			23	23		2,295
<u>Navicula tripunctata</u>	202	184	473	225	14	112
<u>Amphora ovalis</u> v. <u>pecidulus</u>	135	30	1,417	1,283	2	3,881
<u>Cymbella affinis</u>	348	232	135	225	41	45
<u>Cymbella ventricosa</u>	157	277	248	23	27	34
<u>Gomphonema ventricosa</u>	338	161	405	23	64	157
<u>Epithemia sorex</u>	23,490	27,604	16,695	12,487	9,734	10,451
<u>Nitzschia chasei</u>	147	45	382	135	54	337
<u>Nitzschia dissapata</u>	2,194	1,852	4,085	1,238	518	2,014
<u>Nitzschia frustulum</u>	1,204	1,155	1,553	877	369	1,507

Table 3-8-165. Mean densities of the major algal taxa observed in the periphyton from artificial substrates at the White River Stations during RBOSP Aquatic Baseline Studies, May - June 1975.

	Station
	<u>23</u>
CYANOPHYTA	
<u>Plectonema spp.</u>	
CHRYSTOPHYTA	
<u>Cyclotella meneghiniana</u>	1
<u>Synedra amphicephala</u>	1
<u>Synedra pulchella</u>	
<u>Achnanthes minutissima</u>	17
<u>Navicula cryptocephala</u>	4
<u>Cymbella affinis</u>	
<u>Cymbella sinuata</u>	8
<u>Cymbella ventricosa</u>	1
<u>Gomphonema intricatum</u>	1
<u>Gomphonema olivaceum</u>	59
<u>Nitzschia frustulum</u>	1
<u>Nitzschia palea</u>	9
<u>Surirella ovata</u>	1

Table 3-8-166. Mean densities of the major algal taxa observed in the periphyton from artificial substrates at the White River Stations during RBOSP Aquatic Baseline Studies, July - August 1975.

	Station			
	<u>23</u>	<u>27</u>	<u>29</u>	<u>35</u>
CYANOPHYTA				
<u>Lyngbya</u> spp.		36	17	27
CHRYSOPHYTA				
<u>Diatoma</u> <u>vulgare</u>	146	7	5	13
<u>Synedra</u> <u>ulna</u>	219	23	48	148
<u>Achnanthes</u> <u>minutissima</u>	26	13	2	
<u>Navicula</u> <u>cryptocephala</u>	140	131	61	57
<u>Navicula</u> <u>salinarum</u> var. <u>intermedia</u>	112	20	27	18
<u>Navicula</u> <u>tripunctata</u>	63	77	7	2
<u>Navicula</u> <u>viridula</u>	62	70	37	16
<u>Cymbella</u> <u>ventricosa</u>	64	61	20	13
<u>Gomphonema</u> <u>intricatum</u>	41	59	43	23
<u>Gomphonema</u> <u>olivaceum</u>	264	434	652	273
<u>Gomphonema</u> <u>parvulum</u>	157	39	88	173
<u>Nitzschia</u> <u>dissipata</u>	182	311	51	14
<u>Nitzschia</u> <u>holsatica</u>	588	79	320	298
<u>Nitzschia</u> <u>palea</u>				

Table 3-8-167. Mean densities of the major algal taxa observed in the periphyton from artificial substrates at the White River Stations during RBOSP Aquatic Baseline Studies, August - September 1975.

	Station			
	<u>23</u>	<u>27</u>	<u>29</u>	<u>35</u>
CYANOPHYTA				
<u>Lyngbya</u> spp.	23		90	54
CRYSOPHYTA				
<u>Achnanthes minutissima</u>	87	10	33	37
<u>Navicula cryptocephala</u>	250	29	292	112
<u>Navicula salinarium</u> v. <u>intermedia</u>	292	40	483	274
<u>Navicula tripunctata</u>	83	13	172	29
<u>Cymbella affinis</u>	20	11	146	77
<u>Cymbella ventricosa</u>	36	8	26	9
<u>Gomphonema intricatum</u>	36	22	195	14
<u>Gomphonema olivacium</u>	27	15	349	16
<u>Epithemia sorex</u>	14,755	440	4,890	2,937
<u>Nitzschia chasei</u>	18	8	94	73
<u>Nitzschia dissipata</u>	1,013	86	3,165	590
<u>Nitzschia frustulum</u>	847	31	401	609
<u>Nitzschia holsatica</u>	99	17	37	73
<u>Nitzschia latens</u>			15	

Table 3-8-168. Algal taxa observed in the periphyton in the White River above the confluence with Yellow Creek during RBOSP Aquatic Baseline Studies between October-November 1974 and August-September 1975.

CYANOPHYTA

Lyngbya spp.
Oscillatoria spp.
Schizothrix spp.
Anabaena spp.
Plectonema spp.
Calothrix spp.
Rivularia spp.

CHLOROPHYTA

Stigeoclonium spp.
Cladophora fracta
Cladophora glomerata
Cladophora spp.
Closterium parvulum

CHRYSTOPHYTA

Chrysophyta I
Bicoeca lacustris
Melosira varians
Thalassiosira fluviatilis
Cyclotella meneghiniana
Stephanodiscus astraea
Stephanodiscus tenuis
Diatoma hiemale
Diatoma vulgare
Fragilaria construens
Fragilaria leptostauron
Fragilaria pinnata
Fragilaria vaucheriae
Synedra amphicephala
Synedra delicatissima
Synedra minuscula
Synedra ulna
Asterionella formosa
Cocconeis pediculus
Cocconeis placentula
Achnanthes lanceolata
Achnanthes minutissima
Achnanthes sp. I
Rhoicosphenia curvata
Amphipleura pellucida
Gyrosigma acuminatum

Table 3-8-168. Continued.

Pleurosigma delicatulum
Navicula arvensis
Navicula capitata
Navicula cryptocephala
Navicula cuspidata
Navicula minima
Navicula mutica
Navicula pelliculosa
Navicula peregrina
Navicula pupula
Navicula rhyncocephala
Navicula salinarum
Navicula salinarum var. intermedia
Navicula tantula
Navicula tripunctata
Navicula vaucheriae
Navicula viridula
Navicula sp. 1
Navicula sp. 2
Navicula sp. 4
Caloneis amphisbaena
Caloneis bacillum
Caloneis ventricosa
Pinnularia brebissonii
Amphora ovalis
Amphora ovalis var. pediculus
Amphora perpusilla
Amphora sp. 1
Cymbella affinis
Cymbella cistula
Cymbella mexicana
Cymbella prostrata
Cymbella sinuata
Cymbella tumida
Cymbella ventricosa
Cymbella sp. 1
Didymosphenia geminata
Gomphonema gracile
Gomphonema intricatum
Gomphonema olivaceum
Gomphonema parvulum
Gomphonema ventricosum
Gomphonema sp. 1
Gomphonema sp. 2
Epithemia sorex
Epithemia zebra
Rhopalodia gibba
Rhopalodia gibberula

Table 3-8-168. Continued.

<u>Hantzschia</u>	<u>amphioxys</u>
<u>Nitzschia</u>	<u>acicularis</u>
<u>Nitzschia</u>	<u>amphibia</u>
<u>Nitzschia</u>	<u>apiculata</u>
<u>Nitzschia</u>	<u>baccata</u>
<u>Nitzschia</u>	<u>capitellata</u>
<u>Nitzschia</u>	<u>chasei</u>
<u>Nitzschia</u>	<u>denticula</u>
<u>Nitzschia</u>	<u>dissipata</u>
<u>Nitzschia</u>	<u>fonticola</u>
<u>Nitzschia</u>	<u>frustulum</u>
<u>Nitzschia</u>	<u>gracilis</u>
<u>Nitzschia</u>	<u>holsatica</u>
<u>Nitzschia</u>	<u>hungarica</u>
<u>Nitzschia</u>	<u>linearis</u>
<u>Nitzschia</u>	<u>longissima</u> var. <u>closterium</u>
<u>Nitzschia</u>	<u>microcephala</u>
<u>Nitzschia</u>	<u>palea</u>
<u>Nitzschia</u>	<u>sigmoidea</u>
<u>Nitzschia</u>	<u>vermicularis</u>
<u>Nitzschia</u>	<u>sp. 1</u>
<u>Cymatopleura</u>	<u>solea</u>
<u>Surirella</u>	<u>ovata</u>
<u>Surirella</u>	<u>ovalis</u>

In August - September 1975 collections, Epithemia sorex was dominant at Stations 23-27, ranging from 10,440 cells/mm² to 29,981 cells/mm². Amphora ovalis var. pediculus, Navicula cryptocephala, Nitzschia dissipata, Nitzschia frustulum, Nitzschia chasei and Lyngbya spp. were abundant but to a lesser extent.

Algal populations occurring on the artificial substrates during May - June 1975 were dominated by Gomphonema olivacium. In July - August, Gomphonema olivacium, Nitzschia holsatica, and Nitzschia dissipata developed as dominant species on the substrates. In August - September 1975, Epithemia sorex, and to a lesser extent Nitzschia dissipata and Nitzschia frustulum, were the most abundant species occurring on the artificial substrates.

Densities of major algal taxa in periphyton collections at White River Stations 28-29 from October 1974 to September 1975 are summarized in Tables 3-8-159 through 3-8-167. Algal taxa observed from Stations 28-29 during the one year sampling period are listed in Table 3-8-169.

Dominant species from the October - November 1974 samples were Epithemia sorex, Navicula salinarium var. intermedia, Navicula cryptocephala, Achnanthes minutissima and Lyngbya spp. In December 1974 - January 1975 the most abundant species were Achnanthes minutissima, Epithemia sorex, Lyngbya spp. and Navicula tripunctata.

Species dominance had changed by April 1975; Navicula viridula, Nitzschia dissipata, Gomphonema olivacium and Navicula cryptocephala were the most abundant components of the periphyton community. Epithemia sorex, Calothrix spp., Plectonema spp., and Achnanthes minutissima were the other common taxa.

Periphyton cell densities of the collection year were lowest in May - June 1975. Nitzschia frustulum, Amphora ovalis var. pediculus and Navicula cryptocephala were the most abundant species.

Most abundant species from the July - August 1975 samples were Lyngbya spp. and Amphora ovalis var. pediculus. Navicula cryptocephala, Gomphonema

Table 3-8-169. Algal taxa observed in the periphyton in the White River at the confluence with Yellow Creek during RBOSP Aquatic Baseline Studies between October-November 1974 and August-September 1975.

CYANOPHYTA

Lyngbya spp.
Oscillatoria spp.
Plectonema spp.
Calothrix spp.
Rivularia spp.

CHRYSTOPHYTA

Chrysophyta I
Bicoeca lacustris
Cyclotella meneghiniana
Diatoma vulgare
Fragilaria construens
Fragilaria leptostauron
Fragilaria pinnata
Fragilaria vaucheriae
Synedra amphicephala
Synedra delicatissima
Synedra pulchella
Synedra ulna
Cocconeis pediculus
Cocconeis placentula
Achnanthes lanceolata
Achnanthes minutissima
Rhoicosphenia curvata
Amphipleura pellucida
Gyrosigma acuminatum
Pleurosigma delicatulum
Navicula arvensis
Navicula capitata
Navicula cryptocephala
Navicula minima
Navicula pelliculosa
Navicula pupula
Navicula salinarum
Navicula salinarum var. intermedia
Navicula subhamulata
Navicula tantula
Navicula tripunctata
Navicula vaucheriae
Navicula viridula
Navicula sp. 1
Navicula sp. 2
Navicula sp. 4

Table 3-8-169. Continued.

Navicula sp. 5
Caloneis amphisbaena
Caloneis bacillum
Amphora ovalis
Amphora ovalis var. pediculus
Amphora perpusilla
Cymbella affinis
Cymbella delicatula
Cymbella mexicana
Cymbella obtususcula
Cymbella sinuata
Cymbella tumida
Cymbella ventricosa
Gomphonema constrictum
Gomphonema intricatum
Gomphonema olivaceum
Gomphonema parvulum
Gomphonema ventricosum
Gomphonema sp. 1
Epithemia sorex
Epithemia zebra
Rhopalodia gibba
Rhopalodia gibberula
Nitzschia acicularis
Nitzschia capitellata
Nitzschia chasei
Nitzschia denticula
Nitzschia dissipata
Nitzschia fonticola
Nitzschia frustulum
Nitzschia gracilis
Nitzschia holsatica
Nitzschia hungarica
Nitzschia linearis
Nitzschia microcephala
Nitzschia palea
Nitzschia sigmoidea
Nitzschia vermicularis
Cymatopleura solea
Surirella angustata
Surirella ovata
Surirella ovalis

olivacium, Nitzschia dissipata, and Synedra ulna were also common at these stations during July - August 1975.

August - September 1975 periphyton communities at the Yellow Creek confluence were dominated by Epithemia sorex and Lyngbya spp. Common species included Nitzschia dissipata, Navicula salinarum var. intermedia, and Amphora ovalis var. pediculus.

Gomphonema olivaceum and Nitzschia holsatica were the dominant taxa on the artificial substrates at Station 29 in July - August. Cell densities in August - September increased seven times over densities of July - August. The most abundant species were Epithemia sorex and Nitzschia dissipata.

Algal densities of major taxa observed from periphyton collections at the lower White River stations (30-35) from October 1974 to September 1974 are summarized in Tables 3-8-159 through 3-8-167. Algal taxa observed from Stations 30-35 during the one year sampling period are listed in Table 3-8-170.

Dominant algae from the October - November 1974 samples of the stations below the confluence of Yellow Creek were Epithemia sorex, Calothrix spp., Navicula salinarum var. intermedia and Lyngbya spp.

In the December 1974 - January 1975 samples the periphyton community was dominated by Epithemia sorex, Lyngbya spp., Diatoma vulgare, and Nitzschia dissipata. Calothrix spp., Navicula cryptocephala and Cymbella affinis were also common.

Samples from the April 1975 collections had Epithemia sorex, Navicula viridula, and Navicula cryptocephala as relatively equal dominants. Nitzschia dissipata, Navicula tripunctata and Gomphonema olivacium were also abundant to a lesser extent.

Total cell densities were low in samples from May - June 1975. The small diatoms, Amphora ovalis var. pediculus and Nitzschia frustulum were overall

Table 3-8-170. Algal taxa observed in the periphyton in the White River below the confluence with Yellow Creek during RBOSP Aquatic Baseline Studies between October-November 1974 and August-September 1975.

CYANOPHYTA

Lyngbya spp.
Oscillatoria spp.
Plectonema spp.
Calothrix spp.
Rivularia spp.

CHRYSTOPHYTA

Chrysophyta I
Melosira varians
Thalassiosira fluviatilis
Cyclotella meneghiniana
Stephanodiscus tenuis
Diatoma hiemale
Diatoma vulgare
Ceratoneis arcus
Fragilaria construens
Fragilaria leptostauron
Fragilaria pinnata
Fragilaria vaucheriae
Hannaea arcus
Synedra amphicephala
Synedra delicatissima
Synedra minuscula
Synedra pulchella
Synedra tenera
Synedra ulna
Asterionella formosa
Cocconeis pediculus
Cocconeis placentula
Achnanthes lanceolata
Achnanthes minutissima
Rhoicosphenia curvata
Amphipleura pellucida
Frustulia rhomboides
Gyrosigma acuminatum
Pleurosigma delicatulum
Diploneis oculata
Navicula arvensis
Navicula cryptocephala
Navicula minima
Navicula mutica
Navicula pelliculosa
Navicula pupula

Table 3-8-170. Continued.

<u>Navicula</u>	<u>radiosa</u>
<u>Navicula</u>	<u>salinarum</u>
<u>Navicula</u>	<u>salinarum</u> var. <u>intermedia</u>
<u>Navicula</u>	<u>subhamulata</u>
<u>Navicula</u>	<u>subminuscula</u>
<u>Navicula</u>	<u>tantula</u>
<u>Navicula</u>	<u>tripunctata</u>
<u>Navicula</u>	<u>vaucheriae</u>
<u>Navicula</u>	<u>viridula</u>
<u>Navicula</u>	<u>spp.</u>
<u>Navicula</u>	<u>sp. 1</u>
<u>Navicula</u>	<u>sp. 2</u>
<u>Navicula</u>	<u>sp. 4</u>
<u>Caloneis</u>	<u>amphisbaena</u>
<u>Caloneis</u>	<u>bacillum</u>
<u>Caloneis</u>	<u>ventricosa</u>
<u>Pinnularia</u>	<u>brebissonii</u>
<u>Amphora</u>	<u>ovalis</u>
<u>Amphora</u>	<u>ovalis</u> var. <u>pediculus</u>
<u>Amphora</u>	<u>perpusilla</u>
<u>Amphora</u>	<u>spp.</u>
<u>Amphora</u>	<u>sp. 1</u>
<u>Cymbella</u>	<u>affinis</u>
<u>Cymbella</u>	<u>cistula</u>
<u>Cymbella</u>	<u>mexicana</u>
<u>Cymbella</u>	<u>prostrata</u>
<u>Cymbella</u>	<u>sinuata</u>
<u>Cymbella</u>	<u>turgida</u>
<u>Cymbella</u>	<u>ventricosa</u>
<u>Didymosphenia</u>	<u>geminata</u>
<u>Gomphonema</u>	<u>constrictum</u>
<u>Gomphonema</u>	<u>intricatum</u>
<u>Gomphonema</u>	<u>olivaceum</u>
<u>Gomphonema</u>	<u>parvulum</u>
<u>Gomphonema</u>	<u>ventricosum</u>
<u>Gomphonema</u>	<u>sp. 1</u>
<u>Amphiprora</u>	<u>alata</u>
<u>Amphiprora</u>	<u>ornata</u>
<u>Epithemia</u>	<u>sorex</u>
<u>Rhopalodia</u>	<u>gibba</u>
<u>Rhopalodia</u>	<u>gibberula</u>
<u>Nitzschia</u>	<u>acicularis</u>
<u>Nitzschia</u>	<u>angustata</u>
<u>Nitzschia</u>	<u>apiculata</u>
<u>Nitzschia</u>	<u>baccata</u>
<u>Nitzschia</u>	<u>capitellata</u>
<u>Nitzschia</u>	<u>chasei</u>

Table 3-8-170. Continued.

<u>Nitzschia</u>	<u>denticula</u>
<u>Nitzschia</u>	<u>dissipata</u>
<u>Nitzschia</u>	<u>fonticola</u>
<u>Nitzschia</u>	<u>frustulum</u>
<u>Nitzschia</u>	<u>gracilis</u>
<u>Nitzschia</u>	<u>holsatica</u>
<u>Nitzschia</u>	<u>linearis</u>
<u>Nitzschia</u>	<u>palea</u>
<u>Nitzschia</u>	<u>sigmoidea</u>
<u>Nitzschia</u>	<u>vermicularis</u>
<u>Cymatopleura</u>	<u>solea</u>
<u>Surirella</u>	<u>angustata</u>
<u>Surirella</u>	<u>ovata</u>
<u>Surirella</u>	<u>ovalis</u>

PYRRHOPHYTA

Glenodinium gymnodinium

most abundant. Notably, at Station 31, Bicoeca lacustris dominated at a cell density of 1,256/mm².

In samples from July - August 1975 Lyngbya spp. were the most abundant algae. Amphora ovalis var. pediculus, Navicula cryptocephala, Synedra ulna and Nitzschia dissipata were also common.

In the samples of August - September 1975, Epithemia sorex dominated, with densities of 27,604 cells/mm² at Station 31 and a mean density of 15,201 cells/mm² for Stations 30-35.

Other species that were abundant at these stations were Nitzschia dissipata, Navicula salinarum var. intermedia, Amphora ovalis var. pediculus and Nitzschia frustulum.

Artificial substrate periphyton communities in July - August 1975 at Station 35 were dominated by Nitzschia holsatica and Gomphonema olivacium. The August - September 1975 artificial substrate collections were dominated by Epithemia sorex, Nitzschia frustulum and Nitzschia dissipata.

e. Standing Crops - Mean periphyton cell densities, organic weights and chlorophyll a for the six RBOSP collection areas are presented in Table 3-8-171. Both mean periphyton cell density and organic weight peaked in December 1974 - January 1975 at the Headwater stations. Chlorophyll a standing crops varied little from the May - June to August - September 1975 sampling periods. At the Tract stations highest cell densities occurred in December 1974 - January 1975 and August - September 1975. However, the mean organic weights at the Tract stations peaked in December 1974 - January 1975. Chlorophyll a standing crops increased throughout the warm season.

At the lower Yellow Creek stations (19-22), periphyton cell densities peaked in December 1974 - January 1975, while the highest periphyton organic weight occurred in October - November 1974. Artificial substrate periphyton cell densities and organic weights were considerably lower per unit area than those of the natural substrates, and indicated a fairly constant rate of

Table 3-8-171. Standing crop estimates of periphyton during RBOSP Aquatic Baseline Studies between October - November 1974 and August - September 1975.

		Headwater stations (1-5)	Tract Stations (6-18)	Lower Yellow Creek Stations (19-22)		White River above confluence with Yellow Creek (23-27)		White River at confluence with Yellow Creek (28-29)		White River below confluence with Yellow Creek (30-35)	
				Natural Substrates	Artificial Substrates	Natural Substrates	Artificial Substrates	Natural Substrates	Artificial Substrates	Natural Substrates	Artificial Substrates
Oct- Nov	74	Cell density ¹	3,128	4,453	11,127		15,970	10,223		14,839	
		Organic weight ²	3.1	55.2	127.0		71.9	77.3		41.7	
Dec- Jan	75	Cell density	13,978	7,773	17,038		21,617	7,881		14,258	
		Organic weight	34.3	62.9	103.4		131.1	56.0		721.2	
	April	Cell density	6,963	6,120	4,273		17,582	10,694		8,927	
	75	Organic weight	14.9	16.6	77.3		102.5	65.1		68.5	
3-8-524	May- June	Cell density	3,247	2,359	6,403	3,037	3,432	116	2,203	2,722	
	75	Organic weight	12.3	6.9	56.7	3.9	73.0	2.4	22.5	23.1	
		Phytopigment ³	8.0	9.0	19.0		31.0		17.0	23.0	
July- Aug	75	Cell density	725	5,053	2,106	318	6,183	1,970	7,865	1,496	28,113
		Organic weight	9.3	10.1	33.1	3.7	25.1	5.4	14.3	3.7	18.5
		Phytopigment	8.0	13.0	20.0		59.0		43.0		37.0
Aug- Sept	75	Cell density	1,774	7,846	1,993	975	33,936	9,396	9,318	10,857	26,322
		Organic weight	7.3	8.2	9.9	3.8	63.7	7.0	36.2	14.2	51.1
		Phytopigment	9.0	20.0	22.0		292.0		130.0		218.0

algal colonization and initial growth from the May - June to August - September 1975.

In the upper White River stations the peak mean cell densities occurred in the August - September 1975 samples, but the highest mean organic weight occurred in samples collected in December 1974 - January 1975. Chlorophyll a standing crops increased throughout the warm season. Artificial substrate cell densities and organic weights increased throughout the warm season, but remained much below the standing crops of comparable natural substrate samples.

At the confluence of Yellow Creek with the White River, the highest mean cell densities occurred in the October - November 1974 and April 1975 samples. Organic weights peaked in December 1974 - January 1975. Chlorophyll a was highest in August - September samples. Cell densities and organic weights were lower than those of the natural substrates in July - August 1974, but comparable in August - September 1975.

The White River stations below the confluence of Yellow Creek had the highest mean cell density in July - August 1975 but the highest organic weights occurred in samples collected in December 1974 - January 1975. Chlorophyll a increased over the warm-season collection period to a high of 218 mg/m^2 in August - September. Cell densities and organic weights of artificial substrate samples were considerably lower than those of natural substrates.

f. Diversity - Shannon diversity indices were generally lower in Headwater stations than at other stations (Tables 3-8-172 through 3-8-177). As with most of the Yellow Creek watershed, low diversities were accompanied by relatively low Evenness indices and low numbers of species. Stations 3 and 5 tended to have the highest diversities and greatest number of taxa, while Station 1 had consistently low diversities. Lowest diversities were generally found in the April samples.

Tract station periphyton communities also had low diversities. Station 7 generally had the lowest Shannon diversities. Due to the low Evenness

Table 3-8-172. Diversity indices of periphyton communities of the Headwater Stations during RBOSP Aquatic Baseline Studies, October - November 1974 sampling period through August - September 1975 sampling period.

<u>Station</u>	<u>Shannon Index</u>	<u>Evenness</u>	<u>Richness</u>	<u>Number of Species</u>
October - November 1974				
1	0.97	0.36	0.92	6
2	1.94	0.54	1.53	13
3	2.48	0.65	1.96	13
4	2.11	0.54	1.72	15
5	2.44	0.56	2.19	21
$\bar{x}$	1.99	0.53	1.67	14
December 1974 - January 1975*				
3	2.34	0.54	2.46	22
4	0.92	0.23	1.59	17
$\bar{x}$	1.63	0.38	2.02	20
*Stations 1, 2 and 5 were inaccessible, frozen solid or ice covered during sampling time.				
April 1975				
1	0.94	0.29	1.04	10
2	0.63	0.18	1.12	10
3	2.16	0.53	2.31	15
4	1.25	0.34	1.78	12
5	2.67	0.57	2.69	25
$\bar{x}$	1.53	0.38	1.79	15
May-June 1975				
1	0.46	0.13	1.35	12
2	0.94	0.35	1.21	11
3	2.12	0.49	2.58	20
4	2.34	0.63	2.15	13
5	3.02	0.68	3.11	23
$\bar{x}$	1.77	0.45	2.08	16

Table 3-8-172. Continued.

<u>Station</u>	<u>Shannon Index</u>	<u>Evenness</u>	<u>Richness</u>	<u>Number of Species</u>
July - August 1975				
1	0.97	0.32	1.20	9
2	1.80	0.57	1.47	9
3	3.29	0.77	3.13	19
4	2.47	0.60	2.52	18
5	3.15	0.73	3.25	21
$\bar{x}$	2.34	0.60	2.31	15
Yearly Mean	1.85	0.47	1.97	16

Table 3-8-173. Diversity indices of periphyton communities of the Tract Stations during RBOSP Aquatic Baseline Studies, October - November 1974 sampling period through August - September 1975 sampling period.

<u>Station</u>	<u>Shannon Index</u>	<u>Evenness</u>	<u>Richness</u>	<u>Number of Species</u>
October - November 1974*				
7	1.07	0.36	0.97	8
8	1.93	0.82	1.12	5
9	1.77	0.48	1.75	13
13	2.49	0.58	1.90	19
14	1.37	0.45	1.18	9
$\bar{x}$	1.73	0.54	1.38	11

*Stations 6, 10-12, and 15-18 were dry at the time of sampling.

December 1974 - January 1975*				
8	1.27	0.49	0.98	6
9	2.00	0.57	1.86	12
13	1.20	0.37	1.08	11
14	1.51	0.38	1.64	17
$\bar{x}$	1.50	0.45	1.39	12

*Stations 6, 7, 10-12, and 15-18 were dry or frozen at the time of sampling.

April 1975*				
7	1.03	0.27	1.66	14
8	1.46	0.51	0.73	7
9	1.25	0.34	1.72	13
13	1.57	0.40	1.61	15
14	2.41	0.56	2.10	20
$\bar{x}$	1.54	0.42	1.56	14

*Stations 6, 10-12, and 15-18 were dry at the time of sampling.

May - June 1975*				
6	1.51	0.44	2.43	13
7	2.68	0.63	3.02	19
8	2.01	0.67	1.76	8
9	2.51	0.61	3.04	17
13	2.55	0.76	2.23	10
14	2.05	0.47	2.16	21
$\bar{x}$	2.22	0.60	2.44	15

*Stations 10-12, and 15-18 were dry at the time of sampling.

Table 3-8-173. Continued.

<u>Station</u>	<u>Shannon Index</u>	<u>Evenness</u>	<u>Richness</u>	<u>Number of Species</u>
		July - August 1975*		
7	0.85	0.22	1.96	15
8	1.17	0.35	1.37	10
9	1.99	0.51	2.39	15
13	2.73	0.66	2.32	18
14	2.32	0.51	2.23	23
15	3.83	0.81	2.63	26
17	2.89	0.72	2.15	16
18	3.25	0.84	2.91	15
$\bar{x}$	2.38	0.58	2.24	17
Yearly Mean	1.87	0.52	1.80	14

*Stations 6, 10-12, and 16 were dry at the time of sampling.

Table 3-8-174. Diversity indices of periphyton communities of the Yellow Creek Stations during RBOSP Aquatic Baseline Studies, October - November 1974 sampling period through August - September 1975 sampling period.

<u>Station</u>	<u>Shannon Index</u>	<u>Evenness</u>	<u>Richness</u>	<u>Number of Species</u>
October - November 1974				
19	3.28	0.78	2.63	19
20	1.77	0.51	1.04	11
21	1.45	0.44	0.93	10
22	1.15	0.57	0.70	7
$\bar{x}$	1.91	0.57	1.32	12
December 1974 - January 1975*				
19	3.01	0.69	2.24	21
*Stations 20-22 were frozen at the time of sampling.				
April 1975				
19	3.13	0.76	2.17	18
20	1.74	0.46	1.58	13
21	1.47	0.42	1.31	12
22	1.40	0.40	1.34	13
$\bar{x}$	1.93	0.51	1.60	14
May - June 1975				
19	2.92	0.65	2.51	22
20	0.58	0.17	1.31	12
21	1.57	0.44	1.36	12
22	1.66	0.46	1.25	12
$\bar{x}$	1.68	0.43	1.61	15
20	0.28	0.09	0.99	9
(artificial substrate)				
21	0.91	0.24	1.59	14
(artificial substrate)				

Table 3-8-173. Continued.

<u>Station</u>	<u>Shannon Index</u>	<u>Evenness</u>	<u>Richness</u>	<u>Number of Species</u>
		July - August 1975*		
7	0.85	0.22	1.96	15
8	1.17	0.35	1.37	10
9	1.99	0.51	2.39	15
13	2.73	0.66	2.32	18
14	2.32	0.51	2.23	23
15	3.83	0.81	2.63	26
17	2.89	0.72	2.15	16
18	3.25	0.84	2.91	15
$\bar{x}$	2.38	0.58	2.24	17
Yearly Mean	1.87	0.52	1.80	14

*Stations 6, 10-12, and 16 were dry at the time of sampling.

Table 3-8-174. Diversity indices of periphyton communities of the Yellow Creek Stations during RBOSP Aquatic Baseline Studies, October - November 1974 sampling period through August - September 1975 sampling period.

<u>Station</u>	<u>Shannon Index</u>	<u>Evenness</u>	<u>Richness</u>	<u>Number of Species</u>
October - November 1974				
19	3.28	0.78	2.63	19
20	1.77	0.51	1.04	11
21	1.45	0.44	0.93	10
22	1.15	0.57	0.70	7
$\bar{x}$	1.91	0.57	1.32	12
December 1974 - January 1975*				
19	3.01	0.69	2.24	21
*Stations 20-22 were frozen at the time of sampling.				
April 1975				
19	3.13	0.76	2.17	18
20	1.74	0.46	1.58	13
21	1.47	0.42	1.31	12
22	1.40	0.40	1.34	13
$\bar{x}$	1.93	0.51	1.60	14
May - June 1975				
19	2.92	0.65	2.51	22
20	0.58	0.17	1.31	12
21	1.57	0.44	1.36	12
22	1.66	0.46	1.25	12
$\bar{x}$	1.68	0.43	1.61	15
20	0.28	0.09	0.99	9
(artificial substrate)				
21	0.91	0.24	1.59	14
(artificial substrate)				

Table 3-8-174. Continued.

<u>Station</u>	<u>Shannon Index</u>	<u>Evenness</u>	<u>Richness</u>	<u>Number of Species</u>
July - August 1975				
19	3.37	0.73	2.99	25
20	3.48	0.76	3.39	24
21	2.90	0.72	2.05	17
22	2.21	0.55	1.99	15
$\bar{x}$	2.99	0.69	2.60	20
20	2.62	0.72	2.64	13
(artificial substrate).				
21	3.23	0.77	3.21	19
(artificial substrate)				
Yearly Mean (natural substrates)	2.30	0.58	1.87	16

Table 3-8-175. Diversity indices of periphyton communities of the White River Stations above confluence with Yellow Creek during RBOSP Aquatic Baseline Studies, October - November 1974 sampling period through August - September 1975 sampling period.

<u>Station</u>	<u>Shannon Index</u>	<u>Evenness</u>	<u>Richness</u>	<u>Number of Species</u>
October - November 1974				
23	2.96	0.66	2.34	23
24	2.32	0.53	2.05	21
25	2.04	0.46	2.08	22
26	2.67	0.58	2.43	24
27	1.82	0.44	1.79	18
$\bar{x}$	2.36	0.53	2.14	21
December 1974 - January 1975				
23	2.85	0.63	2.26	23
24	3.36	0.71	2.65	27
25	3.15	0.67	2.60	27
26	3.55	0.73	2.82	29
27	3.10	0.67	2.44	25
$\bar{x}$	3.20	0.68	2.55	26
April 1975				
23	3.73	0.73	2.47	25
24	3.41	0.77	2.34	22
25	3.14	0.70	2.31	23
26	3.01	0.65	2.60	25
27	3.60	0.74	3.04	30
$\bar{x}$	3.31	0.72	2.55	25
May - June 1975				
23	3.20	0.75	2.21	20
24	2.76	0.66	2.04	18
25	2.98	0.76	2.34	15
26	2.83	0.69	2.69	18
27	2.48	0.65	1.56	14
$\bar{x}$	2.84	0.70	2.17	17
23	2.39	0.66	2.69	13
(artificial substrate)				

Table 3-8-175. Continued.

<u>Station</u>	<u>Shannon Index</u>	<u>Evenness</u>	<u>Richness</u>	<u>Number of Species</u>
July - August 1975				
23	3.22	0.69	2.78	25
24	3.46	0.75	2.61	24
25	3.20	0.74	2.55	20
26	3.11	0.68	2.51	23
27	3.44	0.73	2.89	26
$\bar{x}$	3.29	0.72	2.67	24
23	3.54	0.77	3.14	25
(artificial substrate)				
27	3.67	0.75	4.05	30
(artificial substrate)				
Yearly Mean (natural substrates)	3.00	0.67	2.42	23

Table 3-8-176. Diversity indices of periphyton communities of the White River Stations at confluence with Yellow Creek during RBOSP Aquatic Baseline Studies, October - November 1974 sampling period through August - September 1975 sampling period.

<u>Station</u>	<u>Shannon Index</u>	<u>Evenness</u>	<u>Richness</u>	<u>Number of Species</u>
October - November 1974				
28	2.79	0.65	2.11	20
29	2.65	0.61	2.13	20
$\bar{x}$	2.72	0.63	2.12	20
December 1974 - January 1975				
28	2.56	0.68	1.79	15
29	2.69	0.61	2.26	22
$\bar{x}$	2.62	0.64	2.02	19
April 1975				
28	2.69	0.62	2.07	20
29	3.25	0.69	2.78	27
$\bar{x}$	2.97	0.66	2.42	24
May - June 1975				
28	3.78	0.83	2.82	23
29	2.80	0.67	2.41	19
$\bar{x}$	3.29	0.75	2.61	21
July - August 1975				
28	3.39	0.75	2.53	23
29	2.72	0.57	2.72	26.
$\bar{x}$	3.05	0.66	2.63	25
29 (artificial substrate)	2.87	0.62	3.34	25
Yearly Mean (natural substrates)	2.93	0.67	2.36	22

Table 3-8-177. Diversity indices of periphyton communities of the White River Stations below confluence with Yellow Creek during RBOSP Aquatic Baseline Studies, October - November 1974 sampling period through August - September 1975 sampling period.

<u>Station</u>	<u>Shannon Index</u>	<u>Evenness</u>	<u>Richness</u>	<u>Number of Species</u>
October - November 1974				
30	2.05	0.50	1.72	17
31	2.30	0.55	1.83	18
32	3.30	0.73	2.27	23
33	3.23	0.73	2.14	22
34	1.93	0.48	1.59	16
35	2.92	0.66	2.19	21
$\bar{x}$	2.62	0.61	1.96	20
December 1974 - January 1975				
30	3.31	0.70	2.58	26
31	3.24	0.71	2.36	23
32	3.27	0.75	2.14	21
33	3.46	0.73	2.60	26
34	2.35	0.56	1.93	19
35	2.51	0.58	1.96	20
$\bar{x}$	3.02	0.67	2.26	23
April 1975				
30	3.25	0.71	2.45	24
31	2.79	0.69	1.74	17
32	2.63	0.65	1.76	17
33	3.21	0.74	2.15	20
34	3.41	0.78	2.40	20
35	3.10	0.70	2.15	21
$\bar{x}$	3.06	0.71	2.11	20
May - June 1975				
30	2.46	0.63	1.99	15
31	1.45	0.38	1.76	14
32	1.88	0.45	2.09	18
33	2.16	0.53	1.90	16
34	1.87	0.46	1.96	17
35	2.74	0.73	2.22	13
$\bar{x}$	2.09	0.53	1.99	16

Table 3-8+177. Continued.

<u>Station</u>	<u>Shannon Index</u>	<u>Evenness</u>	<u>Richness</u>	<u>Number of Species</u>
July - August 1975				
30	3.08	0.67	2.60	24
31	3.04	0.67	2.49	23
32	3.66	0.77	2.88	28
33	3.49	0.79	2.81	21
34	3.43	0.75	2.90	24
35	3.70	0.79	2.66	26
$\bar{x}$	3.40	0.74	2.72	21
25	2.99	0.70	2.71	20
(artificial substrate)				
Yearly Mean (natural substrate)	2.84	0.65	2.21	21

indices caused by a large degree of dominance, Shannon diversity was lowest in December 1974 - January 1975 and April collections.

Lower Yellow Creek periphyton communities failed to show any major increases in algal taxa although there was a general slight increase in Shannon and Evenness indices over those of the upstream stations. Station 19 had consistently high Shannon diversity, Evenness and number of species. Without the data from this station, the overall diversity of the lower Yellow Creek stations would be slightly lower than at the upstream stations. The only discernible seasonal trend was the peak in diversity in the July - August collections.

White River periphyton communities were similar in diversity above, at, and below the confluence with Yellow Creek. With few exceptions the communities were quite diverse in terms of Shannon indices. This high diversity was largely a function of the lack of dominance as indicated by high Evenness indices. Numbers of species, although higher than in Yellow Creek, were not particularly high. Seasonal trends were not evident and with the possible exception of slightly higher diversities in July - August, the communities remained consistently high in diversity.

5. Discussion - Headwater stations may be characterized as alkaline spring-brook seepage areas. Achnanthes minutissima, Navicula cryptocephala and Nitzschia frustulum were the most abundant algae at most Headwater stations throughout the year; although at Station 1 Bicoeca lacustris dominated during May - June, July - August and August - September 1975.

Achnanthes minutissima is an indicator of high oxygen concentrations in alkaline waters (Lowe, 1974) which were characteristic of the headwater sites throughout the year (Table 3-8-10). Both algal cell density and organic weight peaks occurred in December 1974 - January 1975 and were probably due to one or a combination of several chemical parameters that peaked at this time (calcium, sulfate, nitrate - nitrogen, and hardness).

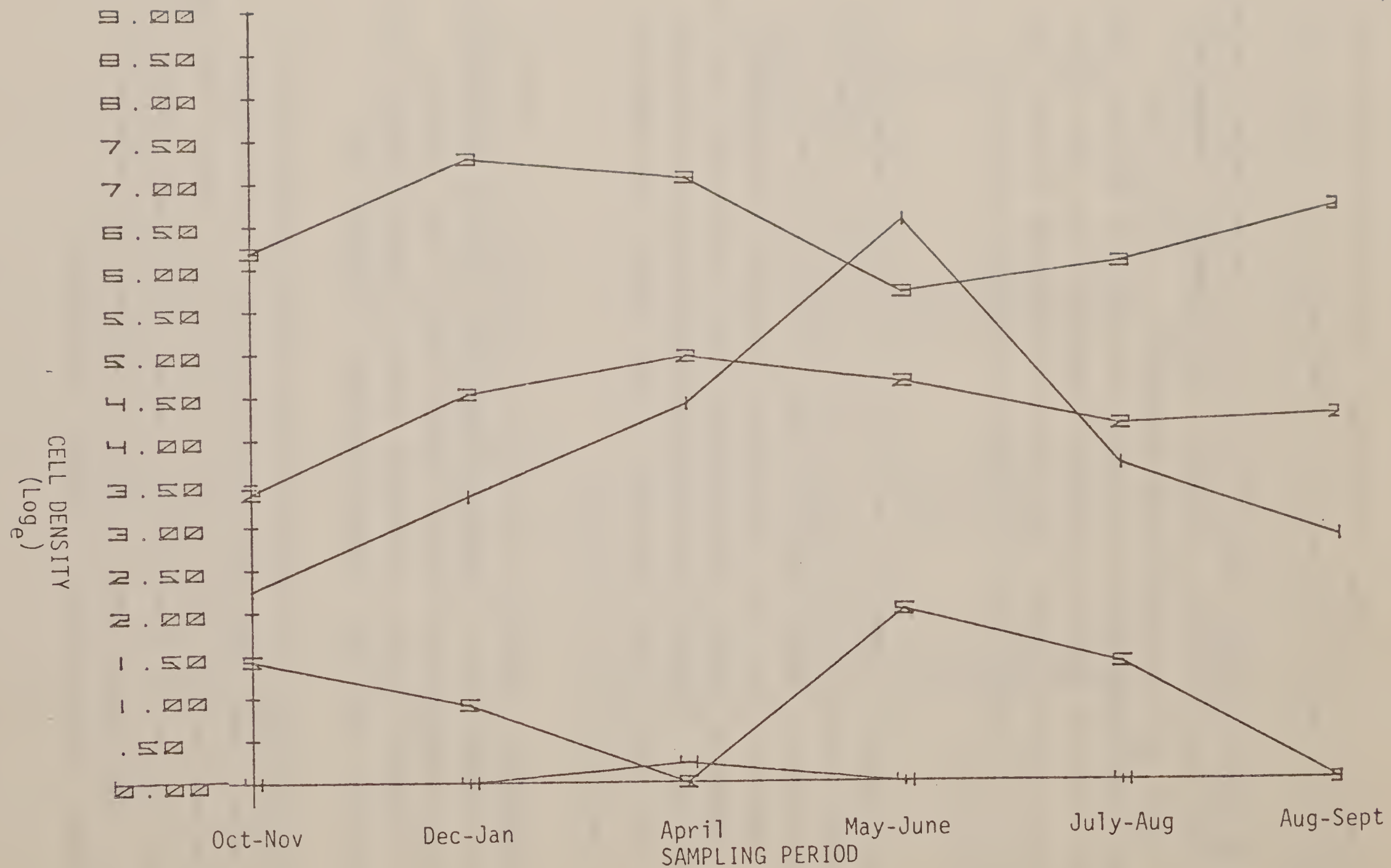


Figure 3-8-20. Log mean densities of the major algal groups in the phytoplankton at the White River Stations at confluence with Yellow Creek during RBOSP Aquatic Baseline Studies October - November 1974 to August - September 1975. (Cyanophyta = 1; Chlorophyta = 2; Chrysophyta = 3; Euglenophyta = 4; Pyrrophyta = 5; and Cryptophyta = 6)

of the Tract stations. Gomphonema intricatum and Nitzschia denticula, two relatively large diatoms, were fairly abundant at this time and probably accounted for the higher organic weights.

The lower section of Yellow Creek (Stations 19-22) can be described as slightly brackish due to very high alkalinity and high conductivity. It also has large quantities of dissolved organic matter. Two general habitat types exist among the sampling stations; the lower stations (20-22) have similar stream conditions, while further upstream, Station 19 was sampled just below a pond habitat. The differences between the habitats are reflected in the species composition of the periphyton communities. Achnanthes minutissima, Fragilaria vaucheriae, Cyclotella meneghiniana, Navicula pelliculosa, Cymbella affinis and Calothrix spp. tended to have higher densities at the lower stations (20-22). Rhopalodia gibberula, Nitzschia denticula, Nitzschia frustulum, Navicula cryptocephala and Navicula sp. 1 tended to have highest densities at Station 19. The abundant species of both areas were alkaliphilous taxa (Lowe, 1975) and both areas had similar total periphyton cell densities. The species composition differences between these two areas were probably due to the higher magnesium, sulfate and total hardness concentrations which occurred at Station 19, in addition to the pond which may have contributed certain taxa. Unlike the above results, Dickman (1973) noted slight increases in blue-green algae in a stream to which bicarbonate was added.

The highest organic weight of periphyton at the lower Yellow Creek stations (19-22) occurred in May - June; while the highest cell densities occurred in December - January. The slight organic weight peak of May - June was probably due to the fairly high number of filamentous blue-green algae and the larger diatom species which occurred on this date.

The artificial substrates at Stations 20 and 21 were dominated by Achnanthes minutissima which was also abundant in samples from the natural substrates. The total cell densities of the artificial substrates tended to be lower than those of the natural substrates, probably due to the lower surface area per unit sampled on the glass slides as opposed to rough rocks.

taxa. In the area of the confluence with Yellow Creek, the diatoms Navicula pelliculosa and Thalassiosira fluviatilis were more abundant than in the other areas of the White River studied.

In May - June 1975, phytoplankton abundance decreased greatly from the April peak and the composition of the phytoplankton differed considerably among the three major study areas of the White River. Above the confluence with Yellow Creek, Chrysophyta and Chlorophyta were dominant; near the confluence with Yellow Creek, Cyanophyta and Chrysophyta were dominant; and below the confluence with Yellow Creek, Chrysophyta and Chlorophyta were again dominant. The most abundant algal taxa above and below the confluence were the diatom Stephanodiscus tenuis and unidentified taxa belonging to Chlorophyta and Cyanophyta. Near the confluence, the diatom Cyclotella meneghiniana and unidentified taxa of Chlorophyta and Cyanophyta were the most abundant algae.

In July - August 1975, Chrysophyta was the dominant group in all three study regions of the White River. The most abundant algae were the diatoms Synedra ulna and Nitzschia holsatica, and an unidentified green flagellate.

In August - September 1975, phytoplankton abundance was slightly greater than during the previous month and Chrysophyta were the dominant algal group. The most abundant species were the diatoms Epithemia sorex, Nitzschia frustulum and Navicula salinarum var. intermedia.

5. Discussion - The species composition and abundance of phytoplankton of the sampling stations in the headwater and tract regions were generally similar (except at Station 17 during August - September 1975 when a great abundance of green and blue-green algae was observed). In both of these regions, the dominant algal group was Chrysophyta, particularly the diatoms. The diatom Achnanthes minutissima appeared to be the most ubiquitous of all the species in the two regions. It was reported by Lowe (1974) to be periphytic, alkaliphilous (best development occurring at pH greater than 7), tolerant to small amounts of salt and common in springs and streams. Lowe (1974) also noted that A. minutissima is very ubiquitous and is a good

substrates bare, while the more protected natural substrates may not have been as disturbed. The species composition of the artificial substrates during July-August and August-September was similar to the respective natural substrates, although cell densities were reduced in comparison to the natural substrates.

Diversity indices measure the complexity of a biotic community by considering the number of species or species richness and the equitability of distributions among the species. High diversity is frequently considered to be an attribute of stable communities, in which major population fluctuations do not occur. Diversity indices of the present study do provide some insight into peculiarities of the system under investigation. The most obvious trend is for lower diversities in the whole Yellow Creek watershed than in the White River. This may be attributed to several factors: 1) the input of algae from more diverse sources in the White River, 2) the generally higher current and more suitable substrates in the White River and 3) the chemically and physically harsher environment of the Yellow Creek watershed.

Specific diversity differences in the Yellow Creek watershed may often be attributed to nearby sources of water or the presence of unusual habitats. The low diversities of Station 1 periphyton communities, for example, may be attributed to the proximity of the sampling site to the spring source of water. Complexity of habitat and availability of a diverse upstream seed source are limiting in such a situation.

The outstandingly high diversities at Station 19 are a function of the unique flora of the station. Rather than attribute the latter to solely chemical factors, the proximity of a pond with unique habitat may also be important. This pool, due to its extensive Chara kieneri growths, undoubtedly promotes the growth of taxa not likely to thrive in the more rapidly flowing sections of the stream.

In general, the diversity indices tended to reflect the greater complexity and stability of White River periphyton over those communities of the Yellow Creek watershed.

All but one of the organic weights from the RBOSP study were within the range of biomass values determined by four authors cited in Cushing (1967). The mean organic weight of Stations 30-35 in December-January was three times higher than the highest value obtained by McIntire et al. (1964). Contrary to the results of Pennak (1974), Yellow Creek stations supported substantial periphyton standing crops.

Chlorophyll a standing crops from the present study were within the range of six authors who used natural or artificial substrates to measure periphyton productivity (cited in Cushing, 1967). Chlorophyll a standing crops of the Yellow Creek watershed were usually lower than those of the White River. White River chlorophyll a standing crops were similar to those reported by Owen (1973) in the Columbia River.

Periphyton standing crops, as measured by numbers, biomass and phytopigments, tended to be lower at the Headwater and Tract stations while the higher standing crops usually occurred in the White River stations. The Yellow Creek stations usually had standing crops that were intermediate between the Headwaters and the White River.

Many of the dominant and abundant periphyton taxa found on the RBOSP site are cosmopolitan species which are common in alkaline waters. Common to abundant species that have been found at both the RBOSP site and in similar hardwater streams were Achnanthes lanceolata, Achnanthes minutissima, Cocconeis placentula, Navicula cryptocephala, Navicula viridula, Cymbella ventricosa, Gomphonema intricatum, Gomphonema parvulum, Gomphonema olivaceum, and Nitzschia palea (Butcher, 1946, Foged, 1947-1949 (cited in Round, 1957). Lowe (1974) noted that Achnanthes minutissima, Cymbella ventricosa, Gomphonema parvulum and Nitzschia palea (species common on the RBOSP site) were indifferent to pH.

Kostelucher and Minshall (1973), in a study of a similar stream habitat, found Diatoma, Epithemia, Gomphonema, Navicula, Nitzschia, Cocconeis and Meridion as common all year. Abundant diatoms from the White River in December - January were Epithemia sorex, Diatoma vulgare and Nitzschia dissipata. At

other collection dates Epithemia sorex, Navicula cryptocephala, Navicula salinarum var. intermedia, Navicula viridula, Nitzschia dissipata, Nitzschia frustulum and Amphora ovalis var. pediculus were abundant at the White River stations, indicating a degree of similarity.

In summary, the diatoms dominated periphyton communities in all waters of the study area. Periphyton standing crops tended to be highest in the White River and lowest in waters near the tract and headwater areas; standing crops in Yellow Creek were intermediate. In general, the species diversity of the periphyton community reflects the complexity of the community and its stability. The highest periphyton species diversities occurred in the White River. The factors which account for this higher diversity include generally greater current velocities and more suitable substrates in the White River and the chemically harsher environment found in other areas. Differences in diversity in the headwaters, tract, and Yellow Creek areas may often be attributed to the proximity to a diverse upstream seed source (the low diversity in the spring at Station 1 was attributed to the absence of such a seed source) or the presence of unusual habitats (the high diversity in the spring at Station 19 is related to its proximity to a pond habitat as well as the unique chemical characteristics of the waters). The same factors which account for the higher diversity of periphyton in the White River also undoubtedly account for the greater standing crops observed there. In general, the species composition of all habitats investigated reflected the alkaline condition of the waters of the region.

D. Benthos

1. Objectives - The objectives of the benthos (macroinvertebrate) studies are to describe the benthos community at each sampling station. This includes taxonomic composition, abundance of these described taxa, and species diversity indices.

2. Methods - At each station, triplicate samples were collected using a modified Surber sampler, an Ekman grab, or a D-frame sampler. In most cases the modified Surber sampler was used. It was proven to be effective in rubble and gravel substrates, and gives quantitative results. The Ekman grab was used at pool Station 14. On several dates it was impossible to collect benthos with conventional quantitative means at certain White River stations. This was due to the water depth, type of substrate, and high current velocities. At such times the D-frame sampler (used as a kick net) was implemented. This sampler gave only qualitative results.

Further problems in sampling were caused by the seasons. In winter, low temperatures brought about flowing slush and ice blocks. Spring floods from snow melt caused the river to overflow its banks. Both of these situations caused benthic sampling to be perilous and, at best, extremely difficult.

After collection, benthos samples were washed in buckets with bottoms fitted with a U.S. Standard No. 30 sieve, and preserved with neutralized 10% formalin.

Standard methods of sample processing and analysis were utilized in the laboratory. The benthic samples were first rinsed in 8-inch No. 60 sieves with light-pressure fine spray to remove any fine sediments. The samples were then hand-sorted under dissecting microscopes at 6X magnification. Organisms were removed from the sample with forceps, eye droppers and probes to petri dishes or watch-glasses containing water. Samples were systematically searched, the examined portions being pushed aside. Any questionable material was also removed along with the organisms and

other collection dates Epithemia sorex, Navicula cryptocephala, Navicula salinarum var. intermedia, Navicula viridula, Nitzschia dissipata, Nitzschia frustulum and Amphora ovalis var. pediculus were abundant at the White River stations, indicating a degree of similarity.

In summary, the diatoms dominated periphyton communities in all waters of the study area. Periphyton standing crops tended to be highest in the White River and lowest in waters near the tract and headwater areas; standing crops in Yellow Creek were intermediate. In general, the species diversity of the periphyton community reflects the complexity of the community and its stability. The highest periphyton species diversities occurred in the White River. The factors which account for this higher diversity include generally greater current velocities and more suitable substrates in the White River and the chemically harsher environment found in other areas. Differences in diversity in the headwaters, tract, and Yellow Creek areas may often be attributed to the proximity to a diverse upstream seed source (the low diversity in the spring at Station 1 was attributed to the absence of such a seed source) or the presence of unusual habitats (the high diversity in the spring at Station 19 is related to its proximity to a pond habitat as well as the unique chemical characteristics of the waters). The same factors which account for the higher diversity of periphyton in the White River also undoubtedly account for the greater standing crops observed there. In general, the species composition of all habitats investigated reflected the alkaline condition of the waters of the region.

D. Benthos

1. Objectives - The objectives of the benthos (macroinvertebrate) studies are to describe the benthos community at each sampling station. This includes taxonomic composition, abundance of these described taxa, and species diversity indices.

2. Methods - At each station, triplicate samples were collected using a modified Surber sampler, an Ekman grab, or a D-frame sampler. In most cases the modified Surber sampler was used. It was proven to be effective in rubble and gravel substrates, and gives quantitative results. The Ekman grab was used at pool Station 14. On several dates it was impossible to collect benthos with conventional quantitative means at certain White River stations. This was due to the water depth, type of substrate, and high current velocities. At such times the D-frame sampler (used as a kick net) was implemented. This sampler gave only qualitative results.

Further problems in sampling were caused by the seasons. In winter, low temperatures brought about flowing slush and ice blocks. Spring floods from snow melt caused the river to overflow its banks. Both of these situations caused benthic sampling to be perilous and, at best, extremely difficult.

After collection, benthos samples were washed in buckets with bottoms fitted with a U.S. Standard No. 30 sieve, and preserved with neutralized 10% formalin.

Standard methods of sample processing and analysis were utilized in the laboratory. The benthic samples were first rinsed in 8-inch No. 60 sieves with light-pressure fine spray to remove any fine sediments. The samples were then hand-sorted under dissecting microscopes at 6X magnification. Organisms were removed from the sample with forceps, eye droppers and probes to petri dishes or watch-glasses containing water. Samples were systematically searched, the examined portions being pushed aside. Any questionable material was also removed along with the organisms and

examined under dissecting microscopes. The organisms were then phenotypically sorted and stored in plastic capsules (in 70% ethanol) within 4-dram vials. All plastic capsules and 4-dram vials for a given sample were stored together.

With few exceptions, benthic organisms are identifiable to the generic level without the use of special preparation. Organisms are identified to the lowest taxon possible. Identifications of individuals were usually made under the dissecting microscope or with temporary slides (under water) using a compound microscope.

Chironomidae and Oligochaeta were cleared in xylene and then mounted on permanent slides in Canada balsam. Only complete oligochaetes with intact anterior portions are enumerated.

After identification and enumeration, specimens were separated by lowest identifiable taxon and were stored in sample jars in 70% ethanol, collectively by sample replicate. A special reference or voucher collection has been maintained apart from other specimens.

Only those individuals which were living at the time of collection, as indicated by presence of fleshy tissue, were enumerated for the purpose of estimating populations. Empty mollusc shells, exuvia, reproductive structures, etc. were retained as aids in identification and compilation of qualitative species lists, but were not used for estimates of population densities.

Taxonomic references used in identification of the macroinvertebrates are presented in the literature section at the end of this report.

3. Literature Review - Benthic invertebrates represent those organisms which live on or in the interstices of the bottom substrates. River and stream benthic fauna are considerably different from lake benthic fauna. In river systems, the aquatic insects are the major components of the fauna. Many groups of benthic organisms are restricted to flowing waters. Hynes

(1970) reported that the family Simuliidae (black flies) requires a flowing water habitat. He also indicated that many other higher taxa reach maximum development in flowing waters and contain families which are almost completely restricted to running water. This is certainly the case for the majority of the plecopterans, and for many trichopteran and ephemeropteran families.

Two recent studies which include reports on macroinvertebrates collected from Yellow Creek and White River are pertinent to the present study.

Everhart and May (1973) discussed the biota and chemistry of the Piceance Creek drainage. A more recent publication which deals with the Piceance Basin is that of Pennak (1974).

Pennak (1974) in the summer of 1973 collected macroinvertebrates from Yellow Creek and the White River on five different sampling dates. Stratified random samples were taken using the square foot Surber sampler. One station was located on Yellow Creek at Highway 54 Bridge (elevation 5,800 ft, 1,768 m), near to RBOSP Station 20. Pennak also collected macroinvertebrates from two stations on the White River. One was located 0.5 mi (0.8 km) below confluence of Piceance Creek (elevation 5,900 ft, 1,780 m) with the White River and the other station 0.5 mi (0.8 km) above the confluence of Piceance Creek (elevation 5,960 ft, 1,798 m), with the White River. These two stations are considerably upstream from the RBOSP White River stations.

Everhart and May (1973) and Pennak (1974) have discussed the difficulty of sampling the main channel of the White River. Pennak (1974) stated: "It is difficult to sample for bottom organisms except near shore where the substrate is chiefly rubble." In the center, substrate is often large rubble and boulders and the current velocity is very swift. Current velocity of the White River, depth, and substrate type are the major reasons for sampling difficulty in the center channel. Pennak (1974) emphasized the importance of sampling several times during the open season due to natural variability of the fauna. He described the difficulties in collecting egg stage and early instar organisms.

Mayflies, stoneflies, and caddisflies were not collected by Pennak (1974) from the Yellow Creek station and Pennak believes this is due to exceptionally high salt content in the water. Large numbers of Simuliidae and smaller numbers of Ceratopogonidae and Chironomidae were observed during his studies. These taxa are not considered preferable fish foods for the trout fishery. Adult blackflies (Simuliidae) have been reported as vicious biters of man and cattle.

Pennak (1974) utilized a stream productivity table developed by fisheries researchers in the United States to indicate the variability in the benthic productivity in small Rocky Mountain streams. Using the productivity table as a basis of comparison, Pennak found that Yellow Creek productivity varied from "poor" to "rich", whereas, the White River productivity was "poor" (fewer than 1.076 organisms/m² and less than 11 g/m² of biomass). Pennak (1974) indicated that the genera found in the White River were all typical of Colorado streams draining granitic areas.

Koslucher and Minshall (1973) studied the macroinvertebrate feeding habits in a northern cool-desert stream (Deep Creek, Curlew Valley, Idaho-Utah). Fauna of this area appear very similar to fauna of White River. Such a study gives some insight to possible feeding habits of the genera occurring in similar drainages. They found Hyalella azteca, Baetis tricaudatus, Tricorythodes minutus, Hydropsyche occidentalis and Simulium argus to be herbivores. Odonatans were consistent carnivores. No evident changes in food preferences could be seen as these particular taxa matured through developmental instars. Organisms of Deep Creek were recorded as being opportunistic and feed in proportion to the foods present.

4. Data Summary - In the following paragraphs the discussion of composition of the benthic community is based upon the number of organisms, not upon biovolumes.

a. Headwaters - Taxa collected in the initial year of study at the Headwater stations are listed in Table 3-8-178. Thus far 38 families and 87 genera have been identified. Insect (Chironomidae,

Table 3-8-178. Benthic macroinvertebrate taxa collected from the Headwaters during RBOSP Aquatic Baseline Studies between October-November 1974 and August-September 1975.

PLATYHELMINTHES

Turbellaria

Tricladida

Planariidae

NEMATODA

MOLLUSCA

Gastropoda

Basommatophora

Lymnaeidae

Lymnaea sp.

Physidae

Physa sp.

Planorbidae

Gyraulus sp.

ANNELIDA

Hirudinea

Rhynchobdellida

Glossiphoniidae

Helobdella stagnalis

Oligochaeta

Aeolosomatidae

Haplotaxida

Haplotaxidae

Haplotaxis sp.

Enchytraeidae

Tubificidae

Unidentified sp. 1

Ilyodrilus templetoni

Limnodrilus sp. 1

Limnodrilus claparedeianus

Limnodrilus hoffmeisteri

Limnodrilus spiralis

Limnodrilus udekemianus

Rhyacodrilinae sp.

Rhyacodrilinae sp. 1

Tubifex tubifex

Immatures with capilliform chaeta

Immatures without capilliform chaetae

Naididae

Chaetogaster diastrophus

Nais sp.

Nais behningi

Nais elinguis

Table 3-8-178. Continued

ARTHROPODA

Arachnoidea

Acari

Crustacea

Ostracoda

Amphipoda

Talitridae

Hyalella azteca

Insecta

Collembola

Ephemeroptera

Baetidae

Baetis sp.

Callibaetis sp.

Caenidae

Caenis sp.

Odonata

Zygoptera

Coenagrionidae

Argia sp.

Amphiagrion abbreviatum

Enallagma sp.

Plecoptera

Euholognatha

Capniidae

Capnia spp.

Systellognatha

Perlodidae

Isoperla sp.

Coleoptera

Haliplidae

Dytiscidae

Agabus sp.

Deronectes sp.

Hydaticus sp.

Rhantus sp.

Oreodytes sp.

Hydrophilidae

Trichoptera

Rhyacophilidae

Glossosomatinae

Agapetus sp.

Hydropsychidae

Hydropsyche sp.

Hydroptilidae

Hydroptila sp.

Table 3-8-178. Continued.

Limnephilidae	
	<u>Grammotaulius</u> sp.
	<u>Hesperophylax</u> sp.
Diptera	
Tipulidae	
	<u>Ormosia</u> sp.
	<u>Dicranota</u> sp.
	<u>Pedicia</u> sp.
	<u>Limnophila</u> sp.
	<u>Holorusia</u> sp.
Psychodidae	
	<u>Telmatoscopus</u> sp.
	<u>Pericoma</u> sp.
	<u>Pericoma</u> sp. <u>A</u>
Dixidae	
	<u>Dixa</u> sp.
Thaumaleidae	
Ceratopogonidae	
	<u>Culicoides</u> sp.
Chironomidae	
Tanypodinae	
	<u>Pentaneurini</u> sp.
	<u>Ablabesmyia</u> sp.
	<u>Labrundinia</u> sp.
	<u>Larsia</u> sp.
	<u>Procladius</u> sp.
	<u>Psectrotanypus</u> sp.
	<u>Thienemannimyia</u> group
Podonominae	
	<u>Boreochlus</u> sp.
Diamesinae	
	<u>Diamesinae</u> sp. 1
	<u>Diamesa</u> sp.
	<u>Prodiamesa</u> nr. <u>olivacea</u>
	<u>Pseudodiamesa</u> <u>pertinax</u>
Orthoclaadiinae	
	<u>Chaetocladius</u> sp.
	<u>Corynoneura</u> sp.
	<u>Cricotopus</u> sp.
	<u>Cricotopus</u> <u>cricotopus</u> <u>bicinctus</u>
	<u>Diplocladius</u> sp.
	<u>Eukiefferiella</u> sp.
	<u>Gymnometriocnemus</u> sp.
	<u>Metriocnemus</u> sp.
	<u>Orthocladius</u> sp.
	<u>Paracladius</u> sp.
	<u>Parakiefferiella</u> sp.

Table 3-8-178. Continued.

Paraphaenocladus sp.
Parametriocnemus sp.
Psectrocladius sp.
Pseudosmittia sp.
Thienemanniella sp.
Smittia sp.
Orthoclaadiinae sp. 2
Chironominae
 Chironomini sp.
 Cryptochironomus sp.
 Microtendipes sp.
 Parachironomus sp.
 Paratendipes sp.
 Phaenopsectra phaenopsectra
 Polypedilum fallax group
 Polypedilum tripodura group
 Stictochironomus sp.
 Tanytarsini sp.
 Tanytarsus sp.
 Cladotanytarsus sp.
 Micropsectra sp.
 Paratanytarsus sp.
 Rheotanytarsus sp.
Simuliidae
 Simulium sp.
Stratiomyidae
 Euparyphus sp.
 Stratiomys sp.
Tabanidae
 Tabanus sp.
 Chrysops sp.
Empididae
 Clinocera sp.
 Hemerodromia sp.
 Wiedemannia sp.
Syrphidae
 Chrysogaster sp.
Dolichopodidae
 Hydrophorus sp.
Ephydriidae
Anthomyiidae
 Limnophora sp.
 Limnophora aequifrons
 Limnophora discreta
Muscidae

Ephemeroptera and Simuliidae) and Oligochaeta comprised the majority of organisms. Oligochaeta (aquatic worms) ranged from a low of 1.9% of the total sample in December 1974 - January 1975 to a high of 38.9% in April 1975. Five families of Oligochaeta were represented. Enchytraeidae have been found at all Headwater stations. Naididae was most common in Stations 3 and 4. Whereas, the abundance of tubificidae was generally high at Station 5, it was usually quite low at Stations 1, 2, and 3. Haplotazidae and Aeolostomatidae were rarely encountered.

Chironomidae (non-biting midges) ranged from 19.1% in July - August 1975 to 32.2% of the total benthic fauna of the headwater stations in August - September 1975. Thirty eight genera of Chironomidae have been identified from the headwaters. Orthocladius, Paraphaenocladius, Micropsectra, Eukiefferiella, Parametriocnemus, Diamesa, Pseudodiamesa, and Corynoneura are the most common genera.

The range for Ephemeroptera (mayflies) was a low of 3.3% in July - August 1975 to 53.3% in December 1974 - January 1975. The mayflies were represented mainly by the fusiform-bodied Baetidae. In October - November and December 1974 - January 1975, large numbers of Baetis were recorded at Station 4. Callibaetis and Caenis were present in July - August and August - September 1975 at Station 5.

Simuliidae (blackflies) varied from 2.5% of the total sample in May - June 1975 to 38% in August - September 1975. Thus far one genus, Simulium, has been encountered in the Headwater stations.

Tables 3-8-179 through 3-8-184 summarize the mean densities of the most abundant benthos (excluding Oligochaeta and Chironomidae) that occurred at Stations 1 - 5 on the six different collection dates. From these tables, it is apparent that Nematoda occurs in all of the Headwater stations. There are some taxa which are abundant at only certain of the Headwater stations. Tricladida was collected in October - November 1975 at Station 2, Hyaella azteca was recorded from Station 5 only. The Plecoptera collected in certain of the Headwater stations were mainly the winter stoneflies of the genus Capnia.

Table 3-8-179. Summary of mean densities of the most abundant benthos¹(macroinvertebrates) at the Headwater Stations during RBOSP Aquatic Baseline Studies, October - November 1974. (Data from Surber and Ekman samples are expressed as organisms/m²; data from D Frame samples are organisms/sample.)

<u>Taxa</u>	<u>Station</u>				
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
Sampling Method ²	<u>MS</u>	<u>MS</u>	<u>MS</u>	<u>MS</u>	<u>MS</u>
Tricladida	584				
<u>Hyallela azteca</u>					368
Baetidae	591		66	6087	20
<u>Argia</u>				26	53
Plecoptera	1583	52		1904	
<u>Hydroptila</u>					433
<u>Hesperophylax</u>	906	72			
<u>Ormosia</u>	308	46	13	7	
<u>Dicranota</u>	33	124		13	
<u>Limnophila</u>	197			243	
<u>Holorusia</u>	637	447	269	86	7
Ceratopogonidae	33	7	624	20	584
Simuliidae larvae				2364	6784
<u>Simulium pupae</u>				92	7
<u>Limnophora aequifrons</u>	13	191	118	230	

¹Excluding Oligochaeta and Chironomidae

²Sampling Method: MS = Modified Surber

Table 3-8-180. Summary of mean densities of the most abundant benthos¹(macroinvertebrates) at the Headwater Stations during RBOSP Aquatic Baseline Studies, December 1974 - January 1975.² (Data from Surber and Ekman samples are expressed as organisms/m²; data from D Frame samples are organisms/sample.)

<u>Taxa</u>	<u>Station</u>		
	<u>3</u>	<u>4</u>	<u>5</u>
Sampling Method ³	<u>MS</u>	<u>MS</u>	<u>MS</u>
Nematoda	13	157	10
Baetidae	387	16955	
Baetis	13	1589	
<u>Amphiagrion abbreviatum</u>			158
Plecoptera		210	
Capniidae		105	
Capnia	7	39	
<u>Grammotaulius</u>			99
<u>Dicranota</u>		66	
<u>Holorusia</u>	282	26	
<u>Pericoma</u>	33	7	
Ceratopogonidae	33	26	79
Simuliidae larvae		4906	10
<u>Limnophora aequifrons</u>	20	132	30

¹Excluding Oligochaeta and Chironomidae

²Stations 1 and 2 were inaccessible, frozen solid or ice covered during the time of sampling.

³Sampling Method: MS = Modified Surber

Table 3-8-181. Summary of mean densities of the most abundant benthos¹(macroinvertebrates) at the Headwater Stations during RBOSP Aquatic Baseline Studies, April 1975. (Data from Surber and Ekman samples are expressed as organisms/m²; data from D Frame samples are organisms/sample.)

<u>Taxa</u>	<u>Station</u>				
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
Sampling Method ²	<u>ES</u>	<u>ES</u>	<u>ES</u>	<u>ES</u>	<u>ES</u>
Nematoda		18	54	260	7415
<u>Hyalella azteca</u>					603
Baetidae			42	2147	42
<u>Baetis</u>		30	428	4368	48
Coenagrionidae			6		54
Hydroptilidae					314
<u>Hydroptila</u>					477
<u>Hesperophylax</u>	12	54	18		6
<u>Holorusia</u>		308	217	12	12
Ceratopogonidae	121	24	446	121	10015
Simuliidae larvae			127	3765	7904
<u>Simulium pupae</u>				1979	
<u>Euparyphus</u>	296		24		
<u>Hemerodromia</u>				12	205
<u>Limnophora aequifrons</u>			67	48	6

¹-Excluding Oligochaeta and Chironomidae

²Sampling Method: ES = Elliptical Modified Surber

Table 3-8-182. Summary of mean densities of the most abundant benthos¹(macroinvertebrates) at the Headwater Stations during RBOSP Aquatic Baseline Studies, May - June 1975. (Data from Surber and Ekman samples are expressed as organisms/m²; data from D Frame samples are organisms/sample.)

Taxa	Station				
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
Sampling Method ²	<u>ES</u>	<u>ES</u>	<u>ES</u>	<u>ES</u>	<u>ES</u>
Nematoda	211	36	175		2908
Planorbidae					60
Acari				6	91
<u>Hyalella azteca</u>					308
Baetidae	628	12	6		
<u>Baetis</u>	1134	30	127	6	90
Coenagrionidae					54
<u>Argia</u>					60
Dytiscidae	6	18	30		6
Deronectes					72
<u>Hydroptila</u>			6		404
<u>Holorusia</u>			501		60
Ceratopogonidae	36		115		2148
<u>Culicoides</u>		12	6		6
Simuliidae larvae				6	609

¹Excluding Oligochaeta and Chironomidae

²Sampling Method: ES = Elliptical Modified Surber

Table 3-8-183. Summary of mean densities of the most abundant benthos¹(macroinvertebrates) at the Headwater Stations during RBOSP Aquatic Baseline Studies, July - August 1975. (Data from Surber and Ekman samples are expressed as organisms/m²; data from D Frame samples are organisms/sample.)

Taxa	Station				
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
Sampling Method ²	<u>ES</u>	<u>ES</u>	<u>ES</u>	<u>ES</u>	<u>ES</u>
Nematoda					199
Physidae					163
<u>Helobdella stagnalis</u>	18	12	18	79	9418
Acari					296
<u>Hyalella azteca</u>					718
Baetidae	350	796	18	682	157
<u>Baetis</u>	277	567	12	97	115
Coleoptera	30		91	24	12
Dytiscidae	54	30	12	36	66
Hydroptila					247
<u>Holorusia</u>		115	6	151	24
Ceratopogonidae	12	12		6	5370
Simuliidae larvae	72	953	151	1689	23102
<u>Simulium pupae</u>					386
<u>Limnophora aequifrons</u>	205	6	18	90	12

¹Excluding Oligochaeta and Chironomidae

²Sampling Method: ES = Elliptical Modified Suber

Table 3-8-184. Summary of mean densities of the most abundant benthos¹(macroinvertebrates) at the Headwater Stations during RBOSP Aquatic Baseline Studies, August - September 1975. (Data from Surber and Ekman samples are expressed as organisms/m²; data from D Frame samples are organisms/sample.)

Taxa	Station				
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
Sampling Method ²	<u>ES</u>	<u>ES</u>	<u>ES</u>	<u>ES</u>	<u>ES</u>
Nematoda	24	6	12	18	712
Acari					290
<u>Hyalella azteca</u>					332
Baetidae	266	296	24	374	60
Coenagrionidae					259
Baetis	36	229	24	266	18
Plecoptera	12	344		6	
Limnophilidae	18	127			
Dicranota	12	24			
Holorusia		12	6	24	
Ceratopogonidae	6	18	72		1520
Simuliidae larvae	6	127	24	555	13201
<u>Simulium pupae</u>		96		151	60
Euparyphus	362	6	6		
<u>Limnophora aequifrons</u>		96	30	48	

¹Excluding Oligochaeta and Chironomidae

²Sampling Method: ES = Elliptical Modified Surber

The most common Trichoptera included taxa of Hydroptilidae (purse makers) and two genera of Limnephilidae (*Hesperophylax* and *Grammotaulius*). *Hydroptila* and *Grammotaulius* were collected mainly at Station 5. *Hesperophylax* occurred most often at Stations 1, 2, and 3. Within the order Diptera (in addition to the Chironomidae and Simuliidae), the Tipulidae, Ceratopogonidae, and Anthomyiidae were well-represented in the Headwater stations. The Diptera were particularly abundant at the Headwater stations.

At the Headwater stations during the initial year of study, the composition of the fauna at Stations 1 to 4 was similar, while that of Station 5 was different from the others.

Species diversity indices for the Headwater stations are presented in Table 3-8-185. In the table, the Shannon-Wiener index, evenness, species richness, and mean number of species have been included for each station and sampling period.

The number and richness of species was highest at Station 5. However, evenness is nearer unity at Stations 1 through 4, suggesting that the different populations comprising the communities at Stations 1 through 4 are more evenly distributed.

b. Tract C-a - Taxa collected in the initial year of study at the Tract stations are listed in Table 3-8-186. To date, representatives of 38 families and 83 genera have been identified. As in the Headwater stations, the aquatic insects (primarily the orders Diptera and Ephemeroptera) dominated the benthic fauna. Oligochaeta were also common in the Tract stations. These aquatic worms ranged from 1.6% in August 1975 to 29.7% of the total fauna in June 1975. Six families have been collected from the Tract stations. The Enchytraeidae and Naididae were most abundant, whereas, few Tubificidae, Lumbricidae, Haplotaxidae, and Lumbricidae were observed.

Diptera were abundant at the Tract stations; their percentage abundance ranged from 43.4% in October - November 1974 to 83.4% in August - September 1974. Taxa

Table 3-8-185. Summary of diversity indices for benthic macroinvertebrates collected at the Headwater Stations during RBOSP Aquatic Baseline Studies, October - November 1974 sampling period through August - September 1975 sampling period.

<u>Station</u>	<u>Shannon Index</u>	<u>Evenness</u>	<u>Richness</u>	<u>Number of Species</u>
October - November 1974				
1	2.97	.71	2.09	19
2	2.94	.71	2.11	18
3	2.71	.71	1.60	13
4	2.91	.65	2.42	23
5	2.20	.51	1.99	19
$\bar{x}$	2.75	.66	2.04	20
December - January 1975*				
3	2.95	.74	1.85	16
4	2.06	.44	2.34	25
5	2.76	.64	2.32	20
$\bar{x}$	2.59	.61	2.17	20
*Stations 1 and 2 were inaccessible, frozen solid or ice covered during sampling.				
April 1975				
1	1.48	.46	1.01	9
2	1.98	.49	1.94	17
3	2.92	.66	2.42	21
4	2.93	.64	2.29	23
5	3.31	.65	2.82	33
$\bar{x}$	2.52	.58	2.10	21
May - June 1975				
1	2.46	.67	1.50	13
2	2.48	.90	1.12	7
3	3.41	.81	2.16	19
4	2.29	.95	.89	5
5	3.27	.66	3.08	31
$\bar{x}$	2.78	.80	1.75	15

Table 3-8-185. Continued

<u>Station</u>	<u>Shannon Index</u>	<u>Evenness</u>	<u>Richness</u>	<u>Number of Species</u>
July - August 1975				
1	2.90	.71	2.06	17
2	2.93	.72	1.91	17
3	1.85	.47	1.65	15
4	2.99	.70	2.04	19
5	3.11	.59	3.03	38
$\bar{x}$	2.76	.64	2.14	21
August - September 1975				
1	1.79	.47	1.49	14
2	2.96	.72	2.07	18
3	2.77	.63	2.42	21
4	2.84	.78	1.49	12
5	1.98	.42	2.46	26
$\bar{x}$	2.47	.60	1.99	18
yearly mean	2.65	.65	2.03	19

Table 3-8-186. Benthic macroinvertebrate taxa collected from the Tract Stations during RBOSP Aquatic Baseline Studies between October-November 1974 and August-September 1975.

NEMATODA

MOLLUSCA

Gastropoda

Basommatophora

Physidae

Physa sp.

ANNELIDA

Hirudinea

Rhynchobdellida

Glossiphoniidae

Helobdella stagnalis

Oligochaeta

Haplotaxida

Haplotaxidae

Haplotaxis sp.

Enchytraeidae

Lumbricidae

Tubificidae

Unidentified sp. 1

Ilyodrilus templetoni

Limnodrilus sp. 1

Limnodrilus hoffmeisteri

Limnodrilus udekemianus

Immatures with capilliform chaeta

Immatures without capilliform chaetae

Naididae

Chaetogaster sp.

Nais sp.

Nais elinguis

Lumbriculida

Lumbriculidae

ARTHROPODA

Arachnoidea

Acari

Amphipoda

Talitridae

Hyalella azteca

Insecta

Collembola

Ephemeroptera

Baetidae

Baetis sp.

Callibaetis sp.

Table 3-8-186. Continued.

Heptageniidae
 Epeorus sp.
 Rhithrogena sp.
Leptophlebiidae
Ephemerellidae
 Ephemerella sp.
Tricorythidae
 Tricorythodes sp.
Odonata
 Zygoptera
 Coenagrionidae
 Argia sp.
 Amphiagrion sp.
Plecoptera
 Euholognatha
 Capniidae
 Capnia sp.
 Systellognatha
 Perlodidae
 Isoperla sp.
Hemiptera
 Corixidae
 Cenocorixa bifida bifida
 Cenocorixa utahensis
 Corisella tarsalis
Coleoptera
 Hydraenidae
 Ochthebius sp.
 Dytiscidae
 Agabus sp.
 Deronectes sp.
 Hydroporus sp.
 Hydrovatus sp.
 Hydaticus sp.
 Rhantus sp.
 Oreodytes sp.
 Hydrophilidae
 Helophorus sp.
 Elmidae
Trichoptera
 Hydropsychidae
 Hydropsyche sp.
 Cheumatopsyche sp.
 Hydroptilidae
 Hydroptila sp.
 Limnephilidae
 Grammotaulius sp.

Table 3-8-186. Continued.

Tipulidae

Ormosia sp.

Dicranota sp.

Holorusia sp.

Psychodidae

Pericoma sp.

Culicidae

Ceratopogonidae

Culicoides sp.

Chironomidae

Tanypodinae

Pentaneurini sp.

Ablabesmyia sp.

Labrundinia sp.

Larsia sp.

Procladius sp.

Procladius psilotanypus

Psectrotanypus sp.

Psectrotanypus sp. 2

Thienemannimyia group

Diamesinae

Diamesinae sp. 1

Diamesa sp.

Odontomesa sp.

Pseudodiamesa pertinax

Pseudodiamesa sp. 1

Orthoclaadiinae

Acricotopus sp.

Chaetocladius sp.

Corynoneura sp.

Cricotopus sp.

Cricotopus cricotopus

Cricotopus cricotopus trifascia

Cricotopus isocladius

Cricotopus isocladius c.f. tricinctus

Diplocladius sp.

Eukiefferiella sp.

Gymnometriocnemus sp.

Krenosmittia sp.

Metriocnemus sp.

Orthocladius sp.

Paracladius sp.

Parakeifferiella sp.

Paraphaenocladius sp.

Parametriocnemus sp.

Psectrocladius sp.

Pseudosmittia sp.

Table 3-8-186. Continued

Thienemanniella sp.
Orthoclaadiinae sp. 2
Orthoclaadiinae sp. 3
Chironominae
Chironomini sp.
Chironomus sp.
Chironomus sp. Group 2
Microtendipes sp.
Paratendipes sp.
Phaenopsectra phaenopsectra
Polypedilum fallax group
Stictochironomus sp.
Tanytarsini
Tanytarsus sp.
Micropsectra sp.
Paratanytarsus sp.
Rheotanytarsus sp.
Zavrelia sp.
Simuliidae
Simulium sp.
Stratiomyidae
Euparyphys sp.
Tabanidae
Tabanus sp.
Empididae
Clinocera sp.
Hemerodromia sp.
Dolichopodidae
Hydrophorus sp.
Ephydriidae
Ephydra sp.
Anthomyiidae
Limnophora sp.
Limnophora aequifrons
Limnophora discreta
Muscidae

belonging to the families Chironomidae and Simuliidae were dominant. Simuliidae ranged from a low of less than 1% of the total fauna in April 1975 to a high of 21.4% in December 1974 - January 1975. The Chironomidae composed 22.3% of the fauna in October - November 1974 and 77.5% in July - August 1975. The major genera of Chironomidae at the Tract stations were similar to those of the Headwater stations. Orthocladius, Paraphaenocladius, Eukiefferiella, Macropsectra, Parametriocnemus, Diamesa, and Phaenopsectra were the most common genera.

The most abundant taxa at the Tract stations (excluding Chironomidae and Oligochaeta) are included in Tables 3-8-187 through 3-8-192. Plecoptera (stoneflies) were composed primarily of winter stoneflies of the genus *Capnia*. *Isoperla* also occurred at Stations 8 and 13. Although, the Trichoptera (caddisflies) were not abundant at the Tract stations, Hydropsyche and Hydroptila were occasionally collected in moderate numbers. Ceratopogonidae, Empididae, and Anthomyiidae of the Diptera were also often observed at the Tract stations.

Diversity indices for the Tract stations are summarized in Table 3-8-193. Diversity indices were influenced by several dominant groups which included Chironomidae, Simuliidae and Oligochaeta. Due to the intermittent nature of the Tract stations, very little information is available for certain of these stations.

c. Yellow Creek - Benthic macroinvertebrates observed during the initial year of RBOSP aquatic studies at the Yellow Creek stations (19 - 22) are listed in Table 3-8-194. Thirty-six families represented by 67 genera have been identified from these locations. During most of the one year period, the aquatic insects dominated the benthic community. During the October - November 1974 sampling, however, the Oligochaeta (particularly the Naididae and Tubificidae) were the dominant organisms in the benthic fauna. The percentage composition of the benthic fauna attributed to aquatic insects varied from 7.5% of the fauna in October - November 1974 to 93.1% in December 1974 - January 1975.

Table 3-8-187. Summary of mean densities of the most abundant benthos¹(macroinvertebrates) at the Tract Stations during RBOSP Aquatic Baseline Studies, October - November 1974.² (Data from Surber and Ekman samples are expressed as organisms/m²; data from D Frame samples are organisms/sample.)

Taxa	Station				
	<u>7</u>	<u>8</u>	<u>9</u>	<u>13</u>	<u>14</u>
Sampling Method ³	<u>MS</u>	<u>MS</u>	<u>MS</u>	<u>MS</u>	<u>ED</u>
Nematoda	20	7	40	401	15
Baetidae	1037	7703	46	5608	
Baetis		13		7	
Callibaetis					2486
Plecoptera	85	2318	105	768	
Capniidae		328		13	
Capnia		263			
Isoperla		33		7	
Corixidae					59
Hydropsyche	223				
Holorusia		52		13	
Ceratopogonidae	20		13	52	44
Simuliidae larvae	578	933	72	6554	104
Simulium pupae	151	98		92	
Limnophora aequifrons	7	204	33	578	163
Limnophora discreta		59		125	

¹Excluding Oligochaeta and Chironomidae

²Stations 6, 10 - 12 and 15 - 18 were dry at the time of sampling.

³Sampling Method: ED = Ekman Dredge
MS = modified surber

Table 3-8-188. Summary of mean densities of the most abundant benthos¹(macroinvertebrates) at the Tract Stations during RBOSP Aquatic Baseline Studies, December 1974 - January 1975.² (Data from Surber and Ekman samples are expressed as organisms/m²; data from D Frame samples are organisms/sample.)

<u>Taxa</u>	<u>Station</u>		
	<u>8</u>	<u>9</u>	<u>13</u>
Sampling Method ³	<u>MS</u>	<u>MS</u>	<u>MS</u>
Nematoda	13		611
Baetidae	13744	703	11833
Baetis	39	118	1149
Plecoptera	538	26	447
Capniidae	269	79	979
Capnia	46		269
Isoperla			138
Hydroptila	59		7
Dicranota	26		26
Holorusia			171
Pericoma			33
Ceratopogonidae	7	7	92
Simuliidae larvae	952	7	16062
Euparyphus	7		26
Limnophora aequifrons	105	7	690
Limnophora discreta	145	13	164

¹Excluding Oligochaeta and Chironomidae

²Stations 6, 7, 10-12, 15 and 16 were either dry, snow covered or frozen solid at time of sampling.

³Sampling Method: MS = Modified Surber

Table 3-8-189. Summary of mean densities of the most abundant benthos¹ (macroinvertebrates) at the Tract Stations during RBOSP Aquatic Baseline Studies, April 1975.² (Data from Surber and Ekman samples are expressed as organisms/m²; data from D Frame samples are organisms/sample.)

<u>Taxa</u>	<u>Station</u>				
	<u>7</u>	<u>8</u>	<u>9</u>	<u>13</u>	<u>14</u>
Sampling Method ³	<u>ES</u>	<u>ES</u>	<u>ES</u>	<u>ES</u>	<u>ED</u>
Nematoda	6	18	217	241	252
Baetidae	36	458	694	440	15
Baetis	18	754	597	2245	
Callibaetis					1702
Epeorus		30			
Coenagrionidae				6	15
Isoperla		187		91	
Hydroptila	6				15
Culicidae				24	15
Ceratopogonidae	157	242	127	416	622
Simuliidae larvae	6		30	6	44
Clinocera					44
Hemerodromia		42	24	60	
Limnophora discreta		18		6	

¹Excluding Oligochaeta and Chironomidae

²Stations 6, 10-12 and 15-18 were dry at the time of sampling.

³Sampling Method: ES = Elliptical Modified Surber
ED = Ekman Dredge

Table 3-8-190. Summary of mean densities of the most abundant benthos¹ (macroinvertebrates) at the Tract Stations during RBOSP Aquatic Baseline Studies, May - June 1975.² (Data from Surber and Ekman samples are expressed as organisms/m²; data from D Frame samples are organisms/sample.)

<u>Taxa</u>	<u>Station</u>				
	<u>7</u>	<u>8</u>	<u>9</u>	<u>13</u>	<u>14</u>
Sampling Method ³	<u>ES</u>	<u>ES</u>	<u>ES</u>	<u>ES</u>	<u>ES</u>
Nematoda	12		205	36	119
Baetidae	18		18		
Baetis	374	6	392		
Callibaetis					1021
Coenagrionidae					15
Amphiagrion					163
Dytiscidae	48		12		
Rhantus					14
Hydrophilidae	18				
Ormosia	6		6	6	
Holorusia	18			60	
Ceratopogonidae	133	6	609	12	770
Culicoides	36		97		15
Hemerodromia	48		260	6	

¹Excluding Oligochaeta and Chironomidae

²Stations 6, 10-12, and 15-18 were dry at the time of sampling.

³Sampling Method: ES = Elliptical Modified Surber

Table 3-8-189. Summary of mean densities of the most abundant benthos¹(macroinvertebrates) at the Tract Stations during RBOSP Aquatic Baseline Studies, April 1975.² (Data from Surber and Ekman samples are expressed as organisms/m²; data from D Frame samples are organisms/sample.)

<u>Taxa</u>	<u>Station</u>				
	<u>7</u>	<u>8</u>	<u>9</u>	<u>13</u>	<u>14</u>
Sampling Method ³	<u>ES</u>	<u>ES</u>	<u>ES</u>	<u>ES</u>	<u>ED</u>
Nematoda	6	18	217	241	252
Baetidae	36	458	694	440	15
Baetis	18	754	597	2245	
Callibaetis					1702
Epeorus		30			
Coenagrionidae				6	15
Isoperla		187		91	
Hydroptila	6				15
Culicidae				24	15
Ceratopogonidae	157	242	127	416	622
Simuliidae larvae	6		30	6	44
Clinocera					44
Hemerodromia		42	24	60	
Limnophora discreta		18		6	

¹Excluding Oligochaeta and Chironomidae

²Stations 6, 10-12 and 15-18 were dry at the time of sampling.

³Sampling Method: ES = Elliptical Modified Surber
ED = Ekman Dredge

Table 3-8-190. Summary of mean densities of the most abundant benthos¹ (macroinvertebrates) at the Tract Stations during RBOSP Aquatic Baseline Studies, May - June 1975.² (Data from Surber and Ekman samples are expressed as organisms/m²; data from D Frame samples are organisms/sample.)

<u>Taxa</u>	<u>Station</u>				
	<u>7</u>	<u>8</u>	<u>9</u>	<u>13</u>	<u>14</u>
Sampling Method ³	<u>ES</u>	<u>ES</u>	<u>ES</u>	<u>ES</u>	<u>ES</u>
Nematoda	12		205	36	119
Baetidae	18		18		
Baetis	374	6	392		
Callibaetis					1021
Coenagrionidae					15
Amphiagrion					163
Dytiscidae	48		12		
Rhantus					14
Hydrophilidae	18				
Ormosia	6		6	6	
Holorusia	18			60	
Ceratopogonidae	133	6	609	12	770
Culicoides	36		97		15
Hemerodromia	48		260	6	

¹Excluding Oligochaeta and Chironomidae

²Stations 6, 10-12, and 15-18 were dry at the time of sampling.

³Sampling Method: ES = Elliptical Modified Surber

Table 3-8-191. Summary of mean densities of the most abundant benthos¹ (macroinvertebrates) at the Tract Stations during RBOSP Aquatic Baseline Studies, July - August 1975.² (Data from Surber and Ekman samples are expressed as organisms/m²; data from D-Frame samples are organisms/sample.)

<u>Taxa</u>	<u>Station</u>							
	<u>7</u>	<u>8</u>	<u>9</u>	<u>13</u>	<u>14</u>	<u>15</u>	<u>17</u>	<u>18</u>
Sampling Method ³	<u>ES</u>	<u>ES</u>	<u>ES</u>	<u>ES</u>	<u>ED</u>	<u>ES</u>	<u>ES</u>	<u>ES</u>
Nematoda	12	6	18		385	6	18	
Collembola	6		6	6	15			
Baetidae	332	253	1255	54				
Baetis	127	121	199					
Callibaetis					30			
Coenagrionidae						36		
Coleoptera	66	6	24			6		
Dytiscidae	12	6	42		163	6		
Deronectes					89		24	
Holorusia	6	6	30	6				
Ceratopogonidae	18	6	6		326	12		
Simuliidae larvae	78	6	724		15	12		
Limnophora aequifrons			36	18	44	6		
Muscidae	18	24	30	6		6	18	

¹Excluding Oligochaeta and Chironomidae

²Stations 6, 10-12 and 16 were dry at the time of sampling.

³Sampling Method: ES = Elliptical Modified Surber
ED = Ekman Dredge

Table 3-8-192. Summary of mean densities of the most abundant benthos¹ (macroinvertebrates) at the Tract Stations during RBOSP Aquatic Baseline Studies, August - September 1975.² (Data from Surber and Ekman samples are expressed as organisms/m²; data from D Frame samples are organisms/sample.)

Taxa	Station					
	7	8	9	13	14	17
Sampling Method ³	ES	ES	ES	ES	ED	ES
Nematoda	24	12	6	42	74	
Baetidae	356	307	193	724	1140	12
Baetis	223	1364	66	543		
Callibaetis					533	
Plecoptera		3071	18	935		
Coleoptera		6				567
Dytiscidae		30		6	400	127
Holorusia		54		404		
Ceratopogonidae	6		18	48	118	42
Simuliidae larvae	90	308	2196	519	15	230
Simulium pupae	30	6	54		15	
Hydrophorus						73
Ephydriidae						278
Limnophora aequifrons		60	6	133		211
Limnophora discreta		103		6		54

¹Excluding Oligochaeta and Chironomidae

²Stations 6, 10-12 and 15, 16 and 18 were dry at the time of sampling.

³Sampling Method: ES = Elliptical Modified Surber
ED = Ekman Dredge

Table 3-8-193. Summary of diversity indices for benthic macroinvertebrates collected at the Tract Stations during RBOSP Aquatic Baseline Studies, October - November 1974 sampling period through August - September 1975 sampling period.

<u>Station</u>	<u>Shannon Index</u>	<u>Evenness</u>	<u>Richness</u>	<u>Number of Species</u>
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October - November 1974*

7	3.07	.78	1.75	15
8	1.98	.45	1.97	20
9	2.51	.61	1.98	17
13	2.79	.60	2.35	24
14	2.33	.61	1.54	15
$\bar{x}$	2.53	.61	1.92	18

*Stations 6, 10-12, and 15-18 were dry at the time sampling.

December 1974 - January 1975*

8	1.55	.36	1.90	20
9	2.96	.72	1.91	17
13	3.05	.63	2.47	28
$\bar{x}$	2.52	.57	2.09	22

*Stations 6, 7, 10-12, and 15-18 were dry or frozen at the time of sampling.

April 1975*

7	2.86	.86	1.40	10
8	2.21	.53	1.88	17
9	2.60	.63	1.68	18
13	2.72	.61	2.03	22
14	2.04	.52	1.29	15
$\bar{x}$	2.49	.63	1.66	17

*Stations 6, 10-12, and 15-18 were dry at the time of sampling.

May - June 1975*

6	1.91	.98	.70	4
7	3.46	.82	2.40	19
8	1.19	1.00	.35	2
9	3.43	.76	2.43	23
13	1.97	.93	.81	5
14	2.62	.72	1.33	12
$\bar{x}$	2.43	.87	1.34	11

*Stations 10-12, and 15-18 were dry at the time of sampling.

Table 3-8-193. Continued.

<u>Station</u>	<u>Shannon Index</u>	<u>Evenness</u>	<u>Richness</u>	<u>Number of Species</u>
July - August 1975				
7	3.10	.78	1.98	16
8	2.44	.76	1.24	9
9	3.08	.69	2.53	22
13	2.51	.90	1.10	7
14	1.54	.40	1.45	14
15	1.57	.41	1.74	14
17	1.68	.97	.57	4
18	1.58	1.00	.50	3
$\bar{x}$	2.19	.74	1.89	11
*Stations 6, 10-12, and 16 were dry at the time of sampling.				
August - September 1975				
7	3.13	.79	2.00	15
8	3.20	.74	2.08	20
9	2.13	.54	1.86	16
12	1.80	.91	.64	4
13	3.37	.76	2.40	21
14	2.18	.52	1.65	18
17	2.57	.57	2.12	22
$\bar{x}$	2.63	.69	1.82	16
*Stations 6, 10, 11, 15, 16, and 18 were dry at the time of sampling.				
yearly means	2.47	.69	1.70	16

Table 3-8-194. Benthic macroinvertebrate taxa collected from the Yellow Creek Stations during RBOSP Aquatic Baseline Studies between October-November 1974 and August-September 1975.

CNIDARIA

Hydrozoa

Hydroida

Hydridae

Hydra sp.

NEMATODA

MOLLUSCA

Gastropoda

Basommatophora

Lymnaeidae

Lymnaea sp.

ANNELIDA

Hirudinea

Rhynchobdellida

Glossiphoniidae

Helobdella stagnalis

Oligochaeta

Haplotaxida

Enchytraeidae

Tubificidae

Unidentified sp. 1

Limnodrilus sp. 1

Limnodrilus claparedeianus

Limnodrilus hoffmeisteri

Limnodrilus profundicola

Limnodrilus spiralis

Limnodrilus udekemianus

Tubifex tubifex

Immatures with capilliform chaetae

Immatures without capilliform chaetae

Naididae

Nais sp.

Nais behningi

Nais elinguis

Lumbriculida

Lumbriculidae

ARTHROPODA

Arachnoidea

Acari

Amphipoda

Talitridae

Hyalella azteca

Table 3-8-194. Continued.

Insecta

Collembola

Ephemeroptera

Baetidae

Baetis sp.

Callibaetis sp.

Ephemerellidae

Ephemerella sp.

Tricorythidae

Tricorythodes sp.

Caenidae

Caenis sp.

Odonata

Zygoptera

Coenagrionidae

Argia sp.

Amphiagrion abbreviatum

Enallagma sp.

Anisoptera

Gomphidae

Plecoptera

Euholognatha

Capniidae

Capnia sp.

Systellognatha

Perlodidae

Isoperla sp.

Hemiptera

Gerridae

Gerris sp.

Corixidae

Cenocorixa sp.

Coleoptera

Haliplidae

Halipus sp.

Dytiscidae

Deronectes sp.

Derovatellus sp.

Hydroporus sp.

Dryopidae

Helichus sp.

Elmidae

Dubiraphia sp.

Microcyllloepus sp.

Trichoptera

Hydropsychidae

Hydropsyche sp.

Table 3-8-194. Continued.

Hydroptilidae
 Hydroptila sp.
 Limnephilidae
 Grammotaulius sp.
 Hesperophylax sp.
 Lepidoptera
 Pyralidae
 Diptera
 Tipulidae
 Ormosia sp.
 Psychodidae
 Telmatoscopus sp.
 Thaumaleidae
 Ceratopogonidae
 Culicoides sp.
 Chironomidae
 Tanypodinae
 Pentaneurini sp.
 Ablabesmyia sp.
 Larsia sp.
 Thienemannimyia group
 Diamesinae
 Diamesa sp.
 Odontomesa sp.
 Pseudodiamesa sp.
 Orthocladiinae
 Corynoneura sp.
 Cricotopus sp.
 Cricotopus cricotopus
 Cricotopus cricotopus bicinctus
 Cricotopus isocladius
 Cricotopus isocladius c.f. tricinctus
 Eukiefferiella sp.
 Orthocladius sp.
 Parakiefferiella sp.
 Paraphaenocladius sp.
 Parametriocnemus sp.
 Pseudosmittia sp.
 Thienemanniella sp.
 Orthocladiinae sp. 1
 Orthocladiinae sp. 2
 Chironominae
 Chironomini sp.
 Cryptochironomus sp.
 Microtendipes sp.
 Parachironomus sp.
 Paracladopelma sp.

Table 3-8-194. Continued.

Paratendipes sp.
Phaenopsectra tribelos
Polypedilum fallax group
Polypedilum tripodura group
Pseudochironomus sp.
Stictochironomus sp.
Tanytarsini sp.
Tanytarsus sp.
Micropsectra sp.
Rheotanytarsus sp.
Simuliidae
 Simulium sp.
Stratiomyidae
 Euparyphus sp.
Tabanidae
 Tabanus sp.
 Chrysops sp.
Empididae
 Clinocera sp.
Anthomyiidae
 Limnophora aequifrons
 Limnophora discreta

Diptera were the most abundant of the aquatic insects. The Chironomidae, Simuliidae, and Ceratopogonidae together composed from 46% (October - November 1974) to 74% (December 1974 - January 1975) of the aquatic insect fauna. Among the Chironomidae the most abundant taxa belonging to the Orthocladiinae were Orthocladius, Paraphaenocladius, Eukiefferiella, Cricoptopus, and Parametriocnemus; the most abundant taxa belonging to the Chironomidae were Micropsectra, Paratendipes, and Stichtochironomus. The Simuliidae composed from less than 1% (October - November 1974) to 46.2% (April 1975) of the aquatic insect fauna.

The most abundant benthos (excluding Oligochaeta and Chironomidae) are presented in Tables 3-8-195 through 3-8-200. The fauna at Station 19 is richer than the other stations on the lower Yellow Creek as indicated in the above tables. Table 3-8-201 includes species diversity indices for these stations.

Helobdella stagnalis, a leech, Lymnaea, a snail, and Hyalella azteca, a freshwater scud, occurred almost exclusively at Station 19. Ceratopogonidae, Simuliidae, and Nematoda occurred commonly in all Yellow Creek stations. In general, Ephemeroptera, Odonata, Coleoptera, Trichoptera, and Plecoptera occurred in very low numbers in Yellow Creek. While densities of certain taxa were extremely high, the diversity indices of Yellow Creek were low (Table 3-8-201).

d. White River - In this report, data from the White River is separated into three regions: White River (Stations 23 - 27) above confluence with Yellow Creek; White River (Stations 28 - 29) at confluence with Yellow Creek; White River (Stations 30 - 35) below confluence with Yellow Creek. The data summary for the White River has been based on the quantitative collections made to date. Qualitative collections made with the D-frame sampler were used to enhance taxonomic knowledge, results from the D-frame samples were recorded as numbers of organisms per sample. Species diversity indices were determined only on quantitative information.

Table 3-8-195. Summary of mean densities of the most abundant benthos¹ (macroinvertebrates) at the Yellow Creek Stations during RBOSP Aquatic Baseline Studies, October - November 1974. (Data from Surber and Ekman samples are expressed as organisms/m²; data from D-Frame samples are organisms/sample).

Taxa	Station			
	19	20	21	22
Sampling Method ²	MS	MS	MS	MS
Nematoda	98			7
<u>Helobdella stagnalis</u>	85			
Acari		26	7	
<u>Hyalella azteca</u>	66			20
Collembola		26	7	13
Baetidae	473		20	217
Coenagrionidae	7			26
Gomphidae				13
<u>Deronectes</u>		7		
Hydropsychidae	7	7		
<u>Hydropsyche</u>			7	20
Ceratopogonidae	112	79	98	282
Simuliidae larvae	230	39	335	7
<u>Simulium</u> pupae	39	13		
<u>Chrysops</u>	20			
<u>Limnophora aequifrons</u>		20	13	79

¹Excluding Oligochaeta and Chironomidae

²Sampling Method: MS = Modified Surber

Table 3-8-196. Summary of mean densities of the most abundant benthos¹(macroinvertebrates) at the Yellow Creek Stations during RBOSP Aquatic Baseline Studies, December 1974 - January 1975.² (Data from Surber and Ekman samples are expressed as organisms/m²; data from D Frame samples are organisms/sample.)

<u>Taxa</u>	<u>Station</u>
	<u>19</u>
Sampling Method ³	<u>MS</u>
Nematoda	1011
<u>Helobdella stagnalis</u>	164
Acari	33
<u>Hyalella azteca</u>	171
Baetidae	7
<u>Haliphus</u>	13
<u>Deronectes</u>	13
Hydropsychidae	13
<u>Hydropsyche</u>	13
<u>Hydroptila</u>	26
Ceratopogonidae	1977
Simuliidae larvae	12056
<u>Chrysops</u>	7
<u>Limnophora aequifrons</u>	125

¹Excluding Oligochaeta and Chironomidae

²Stations 20-22 were frozen solid or ice covered during time of sampling.

³Sampling Method: MS = Modified Surber

Table 3-8-197. Summary of mean densities of the most abundant benthos¹(macroinvertebrates) at the Yellow Creek Stations during RBOSP Aquatic Baseline Studies, April 1975. (Data from Surber and Ekman samples are expressed as organisms/m²; data from D Frame samples are organisms/sample.)

<u>Taxa</u>	<u>Station</u>			
	<u>19</u>	<u>20</u>	<u>21</u>	<u>22</u>
Sampling Method ²	<u>ES</u>	<u>ES</u>	<u>ES</u>	<u>ES</u>
Nematoda	863	145	66	109
<u>Lymnaea</u>	24			
Acari	990	217	72	12
<u>Hyalella azteca</u>	91			6
<u>Baetis</u>	434			
Coenagrionidae	78	12		
<u>Deronectes</u>	42			
<u>Hydroptila</u>	102			
<u>Grammotaulius</u>	18			
<u>Ormosia</u>			18	
Ceratopogonidae	2812	2299	392	127
Simuliidae larvae	48738	1762	1231	175
<u>Simulium pupae</u>	2645	97		6
<u>Euparyphus</u>	18			
<u>Chrysops</u>	127			
<u>Clinocera</u>	24			

¹Excluding Oligochaeta and Chironomidae

²Sampling Method: ES = Elliptical Modified Surber

Table 3-8-198. . Summary of mean densities of the most abundant benthos¹(macroinvertebrates) at the Yellow Creek Stations during RBOSP Aquatic Baseline Studies, May - June 1975. (Data from Surber and Ekman samples are expressed as organisms/m²; data from D Frame samples are organisms/sample.)

<u>Taxa</u>	<u>Station</u>			
	<u>19</u>	<u>20</u>	<u>21</u>	<u>22</u>
Sampling Method ²	<u>ES</u>	<u>ES</u>	<u>ES</u>	<u>TS</u>
Nematoda	48	60	24	
<u>Lymnaea</u>	235			
<u>Acari</u>	887	193	990	
<u>Hyallela azteca</u>	12			
<u>Collembola</u>			102	
Coenagrionidae	223			
<u>Argia</u>	302			
Coleoptera	24	6	6	
Dytiscidae	24	6	12	6
Deronectes	42	6		
<u>Hydroptila</u>	115	6		
<u>Pyrallidae</u>			12	
Ceratopogonidae	3113	211	278	12
Simuliidae larvae	11536	242	1587	
<u>Simulium</u> pupae	410	36	332	

¹Excluding Oligochaeta and Chironomidae

²Sampling Method: ES = Elliptical Modified Surber
TS = Tall Modified Surber

Table 3-8-199. • Summary of mean densities of the most abundant benthos¹ (macroinvertebrates) at the Yellow Creek Stations during RBOSP Aquatic Baseline Studies, July - August 1975. (Data from Surber and Ekman samples are expressed as organisms/m²; data from D Frame samples are organisms/sample.)

Taxa	Station			
	19	20	21	22
Sampling Method ²	ES	ES	ES	ES
Nematoda	18	151	18	
Acari	368	6	139	
<u>Hyalella azteca</u>	622			
<u>Caenis</u>	30	6		
Coenagrionidae	48			6
<u>Argia</u>	66	6		
Gomphidae		12		6
Coleoptera		24	6	12
Dytiscidae		18		
<u>Deronectes</u>	30	24	12	18
Elmidae	24			
Ceratopogonidae	54	392	66	30
Simuliidae larvae	537	157	513	6
<u>Simulium pupae</u>	12	18	109	

¹Excluding Oligochaeta and Chironomidae

²Sampling Method: ES = Elliptical Modified Surber

Table 3-8-200. Summary of mean densities of the most abundant benthos¹ (macroinvertebrates) at the Yellow Creek Stations during RBOSP Aquatic Baseline Studies, August - September 1975: (Data from Surber and Ekman samples are expressed as organisms/m²; data from D-Frame samples are organisms/sample.)

<u>Taxa</u>	<u>Station</u>			
	<u>19</u>	<u>20</u>	<u>21</u>	<u>22</u>
Sampling Method ²	<u>ES</u>	<u>ES</u>	<u>ES</u>	<u>ES</u>
Nematoda	36	127	6	6
<u>Lymnaea</u>	1406			
<u>Acari</u>	808		12	
<u>Hyalella azteca</u>	1110			
<u>Collembola</u>			18	
Baetidae	18	36	24	6
<u>Caenis</u>	66			
Coenagrionidae	187		30	
<u>Argia</u>	115			
Gomphidae		6		12
<u>Deronectes</u>		91	127	
Ceratopogonidae	1159	181	48	54
Simuliidae larvae	1949		42	36
<u>Simulium pupae</u>	24		12	

¹Excluding Oligochaeta and Chironomidae

²Sampling Method: ES = Elliptical Modified Surber

Table 3-8-201. Summary of diversity indices for benthic macroinvertebrates collected at the Yellow Creek Station during RBOSP Aquatic Baseline Studies, between October - November 1974 and August - September 1975.

<u>Station</u>	<u>Shannon Index</u>	<u>Evenness</u>	<u>Richness</u>	<u>Number of Species</u>
October - November 1974				
19	2.66	.63	2.11	19
20	2.76	.74	1.85	14
21	2.43	.71	1.41	11
22	1.71	.42	1.90	19
$\bar{x}$	2.39	.63	1.82	16
December 1974 - January 1975				
19	2.21	.50	1.87	22
*Stations 20-22 were frozen at the time of sampling.				
April 1973				
19	2.51	.52	2.49	29
20	2.74	.69	1.62	16
21	2.42	.65	1.35	13
22	2.81	.65	2.15	20
$\bar{x}$	2.62	.63	1.90	20
May - June 1975				
19	2.77	.63	2.02	21
20	2.81	.79	1.57	12
21	2.97	.70	2.14	19
22	1.37	.60	.67	5
$\bar{x}$	2.48	.68	1.60	14
July - August 1975				
19	3.35	.75	2.61	22
20	1.74	.53	1.21	10
21	2.65	.75	1.52	12
22	2.35	.76	1.29	9
$\bar{x}$	2.52	.70	.166	13

Table 3-8-201. Continued.

<u>Station</u>	<u>Shannon Index</u>	<u>Evenness</u>	<u>Richness</u>	<u>Number of Species</u>
August - September 1975				
19	3.27	.75	2.14	21
20	2.51	.85	1.10	8
21	3.03	.87	1.58	11
22	2.85	.83	1.58	13
$\bar{x}$	2.92	.83	1.58	13
yearly means	2.52	.66	1.75	16

Table 3-8-202 lists the taxa collected during the initial year of study. During the initial year, thirty-eight families, including 73 genera, have been observed. This area of the White River above Yellow Creek had a greater diversity of Ephemeroptera, Trichoptera, and Plecoptera than that observed in Yellow Creek, but the density of benthos was lower in this region of the White River than in Yellow Creek (where a few groups occurred in high densities). Aquatic insects were the most abundant group of benthic organisms. Their density ranged from 49.3% of the total benthos in July - August 1975 to 86.9% in April 1975. The Diptera were generally the dominant organisms in this region of the White River; the density of Diptera ranged from 16.3% of the total benthic fauna in August - September 1975 to 42.1% in April 1975. The most abundant group among the Diptera were the Chironomidae (including Orthocladius, Eukiefferiella, Microtendipes, and Rheotanytarsus). At times, the Oligochaeta composed a major portion of the benthic fauna. The percentage composition of the benthic fauna attributed to the Oligochaeta ranged from 11% in April 1975 to 40.9% in July - August 1975. The Tubificidae and Naididae were the most common families of Oligochaeta observed in this region.

Tables 3-8-203 through 3-8-208 summarize the mean densities of the most abundant benthos excluding Oligochaeta and Chironomidae. The Ephemeroptera were comprised primarily of Ephemerella, Rhithrogena, Heptagenia, Baetis and Tricorythodes. Occasional samples contained significant numbers of Choroterpes and Traverella albertana.

Mayflies, which were rarely encountered in the White River, include Ameletus, Lachlania, Centroptilum, Dactylobaetis, Paraleptophelebia, Caenis, Ephoron, and Brachycercus. The common Plecoptera in the White River were Isogenoides, Isoperla and Claassenia. From late fall through early spring, small numbers of Brachyptera and Capniidae were collected. The Trichoptera were relatively numerous throughout the year in the White River with the dominant taxa belonging to the Hydropsychidae. Occasionally, members of the Hydroptilidae and Glossosmiatidae were collected. Individuals of Oecetis and Brachycentrus were rarely noted. Among the minor taxa which were found frequently but in low abundance were Gomphidae (Ophiogomphus), Lepidoptera

Table 3-8-202. Benthic macroinvertebrate taxa collected from the White River above the confluence with Yellow Creek during RBOSP Aquatic Baseline Studies between October-November 1974 and August-September 1975.

NEMATODA

MOLLUSCA

Gastropoda

Basommatophora

Physidae

Physa sp.

ANNELIDA

Oligochaeta

Haplotaxida

Enchytraeidae

Tubificidae

Limnodrilus claparedeianus

Limnodrilus hoffmeisteri

Limnodrilus udekemianus

Tubifex tubifex

Immatures with capilliform chaetae

Immatures without capilliform chaetae

Naididae

Chaetogaster diaphanus

Nais sp.

Nais behningi

Nais elinguis

Pristina sp.

ARTHROPODA

Arachnoidea

Acari

Insecta

Ephemeroptera

Siphonuridae

Ameletus sp.

Baetidae

Baetis sp.

Callibaetis sp.

Dactylobaetis sp.

Lachlania sp.

Heptageniidae

Heptagenia sp.

Rhithrogena sp.

Leptophlebiidae

Paraleptophlebia sp.

Traverella albertana

Choroterpes sp.

Table 3-8-202. Continued.

Ephemerellidae
 Ephemerella sp.
Caenidae
 Brachycercus sp.
Tricorythidae
 Tricorythodes sp.
Polymitarcidae
 Ephoron sp.
Odonata
 Zygoptera
 Coenagrionidae
 Anisoptera
 Gomphidae
 Ophiogomphus sp.
Plecoptera
 Euholognatha
 Taeniopterygidae
 Brachyptera sp.
 Capniidae
 Capnia sp.
 Systellognatha
 Perlodidae
 Isoperla sp.
 Isoperla fulva
 Isogenus sp.
 Perlidae
 Claassenia sabulosa
Hemiptera
 Corixidae
 Trichocorixa sp.
Coleoptera
 Gyrinidae
 Dryopidae
 Helichus sp.
 Elmidae
 Dubiraphia sp.
 Microcylloepus sp.
 Microcylloepus pusillus
 Optioservus sp.
 Zaitzevia sp.
 Zaitzevia parvula
Trichoptera
 Rhyacophilidae
 Glossosomatinae
 Agapetus sp.
 Hydropsychidae
 Hydropsyche sp.
 Cheumatopsyche sp.

Table 3-8-202. Continued.

Hydroptilidae
 Agraylea sp.
 Hydroptila sp.
 Limnephilidae
 Leptoceridae
 Oecetis sp.
 Oecetis avara
 Brachycentridae
 Micrasema sp.
 Brachycentrus sp.
 Lepidoptera
 Pyralidae
 Diptera
 Tipulidae
 Limonia sp.
 Limnophila sp.
 Liriopeidae
 Bittacomorphella sp.
 Culicidae
 Ceratopogonidae
 Chironomidae
 Tanypodinae
 Pentaneurini sp.
 Ablabesmyia sp.
 Thienemannimyia group
 Diamesinae
 Diamesinae sp. 1
 Diamesa sp.
 Monodiamesa sp.
 Odontomesa sp.
 Orthocladiinae
 Cardiocladius sp.
 Cricotopus sp.
 Cricotopus cricotopus
 Cricotopus cricotopus bicinctus
 Cricotopus cricotopus trifascia
 Cricotopus isocladius
 Eukiefferiella sp.
 Microcricotopus sp.
 Orthocladius sp.
 Parakiefferiella sp.
 Paraphaenocladius sp.
 Parametriocnemus sp.
 Thienemanniella sp.
 Smittia sp.
 Orthocladiinae sp. 2
 Chironominae
 Chironomini sp.
 Chironomus sp. group 2

Table 3-8-202. Continued.

Cryptochironomus sp.
Harnischia sp.
Microtendipes sp.
Paracladopelma sp.
Phaenopsectra phaenopsectra
Phaenopsectra ribelos
Polypedilum sp.
Polypedilum tripodura group.
Stictochironomus sp.
Tanytarsini sp.
Cladotanytarsus sp.
Micropsectra sp.
Rheotanytarsus sp.
Simuliidae
 Simulium sp.
Rhagionidae
 Atherix variegata
Empididae
 Clinocera sp.
 Hemerodromia sp.
Muscidae

Table 3-8-203. Summary of mean densities of the most abundant benthos¹(macroinvertebrates at the White River Stations during RBOSP Aquatic Baseline Studies, October - November 1974. (Data from Surber and Ekman samples are expressed as organisms/m²; data from D Frame samples are organisms/sample.)

Taxa	Above Confluence with Yellow Creek				
	Station				
	23	24	25	26	27
Sampling Method ²	DF	MS	DF	DF	MS
Nematoda	2	7		1	26
Baetidae	5	112	4	10	39
Baetis	2	92	17	4	26
Heptagenia		13	6	6	13
Rhithrogena	4	20	3	4	13
Ephemerella	174	808	36	20	138
Tricorythodes	23	329	3	11	177
Plecoptera	11	59	5	8	39
Hydropsychidae	56	230	32	52	46
Hydropsyche	29	355	35	60	
Cheumatopsyche	9	79	1	9	
Hydroptila	43	197	3	10	99
Pyralidae	3	66	6	2	7
Limnophila	11	46	2		
Atherix variegata	1	33	1	1	

¹Excluding Oligochaeta and Chironomidae

²Sampling Method: DF = D Frame
MS = Modified Surber

Table 3-8-204. Summary of mean densities of the most abundant benthos¹(macroinvertebrates) at the White River Stations during RBOSP Aquatic Baseline Studies, December 1974 - January 1975.² (Data from Surber and Ekman samples are expressed as organisms/m²; data from D Frame samples are organisms/sample.)

Taxa	Above Confluence with Yellow Creek		
	Station		
	24	25	26
Sampling Method ³	DF	DF	DF
Baetidae	19	25	32
Baetis	16	36	25
Heptagenia		2	7
Rhithrogena	4	3	6
Ephemerella	86	277	179
Tricorythodes	16	21	44
Brachyptera	2	5	
Capniidae	19	3	9
Capnia	8		
Isoperla	6	16	14
Hydropsychidae	5	47	29
Hydropsyche	34	57	45
Cheumatopsyche	14	7	7
Hydroptila	50	19	47
Pyralidae	1	3	3

¹Excluding Oligochaeta and Chironomidae

²Stations 23 and 27 were frozen solid or ice covered during time of sampling; Stations 28 and 29 (At Confluence with Yellow Creek) were frozen solid or ice covered during sampling.

³Sampling Method: DF = D Frame.

Table 3-8-205. . . Summary of mean densities of the most abundant benthos¹ (macroinvertebrates) at the White River Stations during RBOSP Aquatic Baseline Studies, April 1975. (Data from Surber and Ekman samples are expressed as organisms/m²; data from D Frame samples are organisms/sample.)

<u>Taxa</u>	Above Confluence with Yellow Creek		Station		
	<u>23</u>	<u>24</u>	<u>25</u>	<u>26</u>	<u>27</u>
Sampling Method ²	<u>TS</u>	<u>TS</u>	<u>TS</u>	<u>TS</u>	<u>TS</u>
Nematoda	111	124	46	78	7
Acari	7	13	39	52	13
Baetidae	52	98	39	46	
Baetis	65	234	234	72	20
Ephemerella	949	1742	1697	1846	221
Tricorythodes	111	169	384	806	39
Isoperla	85	377	7	98	13
Hydropsychidae	72	13	7	195	
Hydropsyche	137	20	156	215	
Hydroptila	39	33	46	7	13
Limnophila	91	33	59	7	
Ceratopogonidae	39	59	33		
Atherix variegata	7	72	46		

¹Excluding Oligochaeta and Chironomidae

²Sampling Method: TS = Tall Modified Surber

Table 3-8-206. Summary of mean densities of the most abundant benthos¹ (macroinvertebrates) at the White River Stations during RBOSP Aquatic Baseline Studies, May - June 1975. (Data from Surber and Ekman samples are expressed as organisms/m²; data from D-Frame samples are organisms/sample.)

<u>Taxa</u>	Above Confluence with Yellow Creek		Station		
	<u>23</u>	<u>24</u>	<u>25</u>	<u>26</u>	<u>27</u>
Sampling Method ²	<u>DF</u>	<u>DF</u>	<u>DF</u>	<u>DF</u>	<u>DF</u>
<u>Baetis</u>	1	3	11	4	1
<u>Rhithrogena</u>		1	2	1	
<u>Ephemerella</u>	10	18	55	112	25
<u>Tricorythodes</u>		1	14	6	
<u>Gomphidae</u>				2	
<u>Isoperla</u>			2	5	1
<u>Isoperla fulva</u>				2	
<u>Isogenus</u>			1	1	
<u>Claassenia sabulosa</u>				2	
<u>Hydropsyche</u>		5	26	35	
<u>Cheumatopsyche</u>			4	2	
<u>Hydroptila</u>			2	1	
<u>Pyralidae</u>		1	4		
<u>Simuliidae larvae</u>		1	1	3	
<u>Empididae</u>			2		1

¹Excluding Oligochaeta and Chironomidae

²Sampling Method: DF = D Frame

Table 3-8-205. . . Summary of mean densities of the most abundant benthos¹ (macroinvertebrates) at the White River Stations during RBOSP Aquatic Baseline Studies, April 1975. (Data from Surber and Ekman samples are expressed as organisms/m²; data from D Frame samples are organisms/sample.)

<u>Taxa</u>	Above Confluence with Yellow Creek		Station		
	<u>23</u>	<u>24</u>	<u>25</u>	<u>26</u>	<u>27</u>
Sampling Method ²	<u>TS</u>	<u>TS</u>	<u>TS</u>	<u>TS</u>	<u>TS</u>
Nematoda	111	124	46	78	7
Acari	7	13	39	52	13
Baetidae	52	98	39	46	
Baetis	65	234	234	72	20
<u>Ephemerella</u>	949	1742	1697	1846	221
<u>Tricorythodes</u>	111	169	384	806	39
<u>Isoperla</u>	85	377	7	98	13
Hydropsychidae	72	13	7	195	
<u>Hydropsyche</u>	137	20	156	215	
<u>Hydroptila</u>	39	33	46	7	13
<u>Limnophila</u>	91	33	59	7	
Ceratopogonidae	39	59	33		
<u>Atherix variegata</u>	7	72	46		

¹Excluding Oligochaeta and Chironomidae

²Sampling Method: TS = Tall Modified Surber

Table 3-8-206. Summary of mean densities of the most abundant benthos¹ (macroinvertebrates) at the White River Stations during RBOSP Aquatic Baseline Studies, May - June 1975. (Data from Surber and Ekman samples are expressed as organisms/m²; data from D-Frame samples are organisms/sample.)

<u>Taxa</u>	Above Confluence with Yellow Creek		Station		
	<u>23</u>	<u>24</u>	<u>25</u>	<u>26</u>	<u>27</u>
Sampling Method ²	<u>DF</u>	<u>DF</u>	<u>DF</u>	<u>DF</u>	<u>DF</u>
<u>Baetis</u>	1	3	11	4	1
<u>Rhithrogena</u>		1	2	1	
<u>Ephemerella</u>	10	18	55	112	25
<u>Tricorythodes</u>		1	14	6	
<u>Gomphidae</u>				2	
<u>Isoperla</u>			2	5	1
<u>Isoperla fulva</u>				2	
<u>Isogenus</u>			1	1	
<u>Claassenia sabulosa</u>				2	
<u>Hydropsyche</u>		5	26	35	
<u>Cheumatopsyche</u>			4	2	
<u>Hydroptila</u>			2	1	
<u>Pyralidae</u>		1	4		
<u>Simuliidae larvae</u>		1	1	3	
<u>Empididae</u>			2		1

¹Excluding Oligochaeta and Chironomidae

²Sampling Method: DF = D Frame

Table 3-8-207.. Summary of mean densities of the most abundant benthos¹ (macroinvertebrates) at the White River Stations during RBOSP Aquatic Baseline Studies, July - August 1975. (Data from Surber and Ekman samples are expressed as organisms/m²; data from D Frame samples are organisms/sample.)

<u>Taxa</u>	Above Confluence with Yellow Creek				
	Station				
	<u>23</u>	<u>24</u>	<u>25</u>	<u>26</u>	<u>27</u>
Sampling Method ²	<u>TS</u>	<u>TS</u>	<u>DF</u>	<u>TS</u>	<u>TS</u>
Nematoda	7	20		26	7
Acari		20		7	
Rhithrogena			4	7	
Leptophlebiidae		13			
Ephemerella		7	3	13	
Tricorythodes		7			
Hydropsychidae		7	1		
Hydropsyche		72	3	33	
Leptoceridae				13	
Cheumatopsyche		7	1	7	
Brachycentridae		7	1		
Limnophila	7	13	1	7	
Atherix variegata		20	1		

¹Excluding Oligochaeta and Chironomidae

²Sampling Method: TS = Tall Modified Surber
DF = D Frame

Table 3-8-208. Summary of means of densities of the most abundant benthos¹(macroinvertebrates) at the White River Stations during RBOSP Aquatic Baseline Studies, August - September 1975. (Data from Surber and Ekman samples are expressed as organisms/m²; data from D Frame samples are organisms/sample.)

Taxa	Above Confluence with Yellow Creek				
	Station				
	23	24	25	26	27
Sampling Method ²	TS	TS	DF	TS	TS
Nematoda	7	26	1	7	26
Acari		33		33	
Baetidae	221	52	4	78	
Baetis	13	72	19	124	
Heptagenia	85		2	78	7
Rhithrogena	176	7		72	
Traverella	52	7	2	13	
Choroterpes	124	65	2	202	46
Ephemerella	312	189	1	104	33
Tricorythodes	104	104	1	169	65
Hydropsychidae	839	533	59	1047	20
Hydropsyche	793	351	67	663	7
Hydroptila		26	1	39	7
Limnophila	91	46	2	7	13
Simuliidae larvae	33	33	10	33	

¹Excluding Oligochaeta and Chironomidae

²Sampling Method: TS = Tall Modified Surber
DF = D Frame

Table 3-8-209. Summary of diversity indices for benthic macroinvertebrates collected at the White River Stations above confluence with Yellow Creek during RBOSP Aquatic Baseline Studies from October - November 1974 through August - September 1975.

<u>Station</u>	<u>Shannon Index</u>	<u>Evenness</u>	<u>Richness</u>	<u>Number of Species</u>
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October - November 1974

24	3.40	.73	2.80	25
27	3.61	.83	2.58	20
$\bar{x}$	3.51	.78	2.69	23

*Stations 23, 25, 26 were sampled with a D Frame sampler due to depth current velocity and type of substrate.

December 1974 - January 1975

*Stations 23 and 27 were frozen at the time of sampling.

*Stations 24 - 26 were sampled with a D Frame sampler due to depth current velocity and type of substrate.

April 1975

23	3.50	.74	3.07	27
24	3.32	.71	2.79	26
25	3.04	.66	2.83	24
26	3.21	.71	2.66	24
27	3.04	.79	2.02	17
$\bar{x}$	3.22	.90	3.34	29

May - June 1975

*Stations 23 - 27 were sampled with a D Frame sampler due to depth current velocity and type of substrate.

July - August 1975

23	1.29	1.00	.38	3
24	3.32	.93	1.93	13
26	3.06	.90	1.70	11
27	1.72	.97	.59	4
$\bar{x}$	2.35	.95	1.15	7

*Station 25 was sampled with a D Frame sampler due to depth, current velocity and type of substrate.

Table 3-8-209. Continued.

<u>Station</u>	<u>Shannon Index</u>	<u>Evenness</u>	<u>Richness</u>	<u>Number of Species</u>
August - September 1975				
23	3.76	.77	3.41	29
24	2.72	.56	3.25	29
26	3.22	.66	3.24	28
27	3.28	.78	2.44	19
$\bar{x}$	3.25	.69	3.09	27
*Station 25 was unable to be sampled due to depth current velocity and type of substrate.				
yearly means	3.08	.83	2.57	21

(Pyrallidae), Acari, Collembola, Hemiptera (Corizidae), Coleoptera (Elmidae) and Diptera (Ceratopogonidae, Tipulidae, Simuliidae, Rhagionidae and Empididae).

Species diversity indices are summarized in Table 3-8-209. The species diversity index was higher at these stations than anywhere in the drainage, due to the large number of species and evenness of their distribution.

Taxa observed in the initial year of study at the confluence of the White River and Yellow Creek (Stations 28 - 29) are listed in Table 3-8-210. Fifty-six genera within 30 families have been collected. Insecta were generally dominant at these stations, and the percentage composition of the total benthos ranged from 9.6% in July - August 1975 to 86.9% in April 1975. Ephemeroptera, Diptera, and Trichoptera were the major components of the fauna. By the July - August 1975 sampling the majority of the aquatic insects had completed their juvenile life stages and had emerged from their aquatic habitat. Thus, during this sampling period the Oligochaeta were found to be the most abundant benthic group (their percentage composition of the total benthos ranged from 11% in April 1975 to 88.7% in July - August 1975). The Tubificidae and Naididae were the dominant families of Oligochaeta throughout the study at these sampling locations.

Within the Diptera, the Chironomidae were the most common organisms. Orthocladius was the only abundant taxa although Paraphaenocladius, Parakiefferiella, Microtendipes and Stichtochironomus were common. The most common taxa excluding Oligochaeta and Chironomidae are summarized in Tables 3-8-211 through 3-8-215.

The percentage of Ephemeroptera varied from 1.7% of the total fauna in July - August 1975 to 37.5% in April 1975. Ephemerella, Rhithrogena, Baetis, Tricorythodes, and Aeptagenia were common. Choroterpes was abundant in August - September 1975. The most abundant caddisflies included the net builders of the family Hydropsychidae. The purse makers (Hydroptilidae) were also found in the White River at confluence with Yellow Creek.

Table 3-8-210. Benthic macroinvertebrate taxa collected in the White River at confluence with Yellow Creek during RBOSP Aquatic Baseline Studies between October - November 1974 and August - September 1975.

CNIDARIA

Hydrozoa

Hydroida

Hydridae

Hydra sp.

NEMATODA

ANNELIDA

Oligochaeta

Haplotaxida

Enchytraeidae

Tubificidae

Unidentified sp. 1

Ilyodrilus templetoni

Limnodrilus sp. 1

Limnodrilus claparedeianus

Limnodrilus hoffmeisteri

Limnodrilus profundicola

Limnodrilus spiralis

Limnodrilus udekemianus

Tubifex tubifex

Immatures with capilliform chaetae

Immatures without capilliform chaetae

Naididae

Chaetogaster diaphanus

Chaetogaster diastrophus

Nais sp.

Nais behningi

Nais elinguis

Pristina sp.

Lumbriculida

Lumbriculidae

ARTHROPODA

Arachnoidea

Acari

Insecta

Ephemeroptera

Baetidae

Baetis sp.

Heptageniidae

Heptagenia sp.

Rhithrogena sp.

Table 3-8-210. Continued.

Leptophlebiidae
 Traverella albertana
 Choroterpes sp.
Ephemerellidae
 Ephemerella sp.
Tricorythidae
 Tricorythodes sp.
Odonata
 Zygoptera
 Coenagrionidae
 Anisoptera
 Gomphidae
Plecoptera
 Systellognatha
 Perlodidae
 Isoperla sp.
 Isoperla fulva
 Isogenus sp.
 Chloroperlidae
 Alloperla sp.
 Perlidae
 Claassenia sabulosa
Coleoptera
 Dytiscidae
 Derovatellus sp.
 Elmidae
 Dubiraphia sp.
 Microcylloepus sp.
Trichoptera
 Rhyacophilidae
 Glossosomatinae
 Hydropsychidae
 Hydropsyche sp.
 Cheumatopsyche sp.
 Hydroptilidae
 Hydroptila sp.
 Leptoceridae
 Oecetis sp.
 Brachycentridae
Lepidoptera
 Pyrilidae
Diptera
 Tipulidae
 Limnophila sp.
 Ceratopogonidae
 Chironomidae

Table 3-8-210. Continued.

Tanypodinae

Pentaneurini sp.

Psectrotanypus sp.

Thienemannimyia group sp.

Diamesinae

Monodiamesa sp.

Odontomesa sp.

Orthoclaadiinae

Cardiocladius sp.

Cricotopus sp.

Cricotopus cricotopus

Cricotopus cricotopus bicinctus

Cricotopus cricotopus trifascia

Cricotopus isocladius

Eukiefferiella sp.

Microcricotopus sp.

Orthocladius sp.

Paracladius sp.

Parakiefferiella sp.

Paraphaenocladius sp.

Pseudosmittia sp.

Smittia sp.

Orthoclaadiinae sp. 1

Orthoclaadiinae sp. 3

Chironominae

Chironomini sp.

Chironomus sp.

Chironomus sp. group 2

Cryptochironomus sp.

Dicrotendipes sp.

Microtendipes sp.

Paracladopelma sp.

Phaenopsectra phaenopsectra

Polypedilum sp.

Polypedilum tripodura group

Stictochironomus sp.

Tanytarsini sp.

Tanytarsus sp.

Cladotanytarsus sp.

Micropsectra sp.

Paratanytarsus sp.

Rheotanytarsus sp.

Simuliidae

Simulium sp.

Tabanidae

Tabanus sp.

Rhagionidae

Atherix variegata

Table 3-8-210. Continued.

Empididae
Hemerodromia sp.

Table 3-8-211.

Summary of mean densities of the most abundant benthos¹ (macroinvertebrates at the White River Stations during RBOSP Aquatic Baseline Studies, October - November 1974. (Data from Surber and Ekman samples are expressed as organisms/m²; data from D Frame samples are organisms/sample.)

At Confluence with Yellow Creek		
Taxa	Station	
	28	29
Sampling Method ²	MS	MS
Nematoda	33	125
Baetidae	105	361
Baetis	368	151
Rhithrogena	295	670
Ephemerella	118	26
Plecoptera	2022	158
Claassenia sabulosa		46
Hydropsychidae	26	1143
Hydropsyche	13	913
Limnophila	20	26
Ceratopogonidae	85	20
Simuliidae larvae	7	171
Simulium pupae		26
Hemerodromia		26

¹Excluding Oligochaeta and Chironomidae

²Sampling Method: MS = Modified Surber

Table 3-8-212.

Summary of mean densities of the most abundant benthos¹(macroinvertebrates) at the White River Stations during RBOSP Aquatic Baseline Studies, April 1975. (Data from Surber and Ekman samples are expressed as organisms/m²; data from D Frame samples are organisms/sample.)

<u>Taxa</u>	At Confluence with Yellow Creek	
	<u>28</u>	<u>29</u>
Sampling Method ²	<u>S</u>	<u>TS</u>
Nematoda	99	117
Acari		26
Baetidae	118	26
Baetis	217	52
Rhithrogena	46	33
Ephemerella	1248	631
Tricorythodes	243	
Isoperla	66	91
Hydropsychidae		33
Hydropsyche	6	156
Hydroptila	26	7
Ceratopogonidae	20	52
Simuliidae larvae	7	13
Hemerodromia	7	13

¹Excluding Oligochaeta & Chronomidae

²Sampling Method: S = Modified Surber
TS = Tall Modified Surber

Table 3-8-213. Summary of mean densities of the most abundant benthos¹(macroinvertebrates) at the White River Stations during RBOSP Aquatic Baseline Studies, May - June 1975. (Data from Surber and Ekman samples are expressed as organisms/m²; data from D Frame samples are organisms/sample.)

Taxa	At Confluence with Yellow Creek	
	Station	
Sampling Method ²	28	29
	DF	DF
Baetidae		3
Baetis	1	3
Heptagenia	1	
Rhithrogena	1	4
Ephemerella	4	133
Tricorythodes		1
Isoperla		4
Isogenus		1
Hydropsyche		5
Cheumatopsyche		1
Hydroptila		1
Brachycentridae		2
Simuliidae larvae		7
Simulium pupae		2

¹Excluding Oligochaeta and Chironomidae

²Sampling Method: DF = D Frame

Table 3-8-214. Summary of mean densities of the most abundant benthos¹ (macroinvertebrates) at the White River Stations during RBOSP Aquatic Baseline Studies, July - August 1975. (Data from Surber and Ekman samples are expressed as organisms/m²; data from D Frame samples are organisms/sample.)

<u>Taxa</u>	At Confluence with Yellow Creek	
	Station	
Sampling Method ²	<u>28</u>	<u>29</u>
	<u>TS</u>	<u>TS</u>
Nematoda	13	
Acari	13	7
<u>Rhithrogena</u>		20
<u>Ephemerella</u>	7	
<u>Tricorythodes</u>	7	
<u>Pyralidae</u>		7
<u>Limnophila</u>		7
<u>Ceratopogonidae</u>		7

¹Excluding Oligochaeta and Chironomidae

²Sampling Method: TS = Tall Modified Surber

Table 3-8-215. Summary of mean densities of the most abundant benthos¹(macroinvertebrates) at the White River Stations during RBOSP Aquatic Baseline Studies, August - September 1975. (Data from Surber and Ekman samples are expressed as organisms/m²; data from D Frame samples are organisms/sample.)

Taxa	At Confluence with Yellow Creek	
	Station	
	28	29
Sampling Method ²	TS	TS
Nematoda	7	39
Acari	26	20
Baetidae	13	98
Baetis	13	117
Heptagenia	7	59
Rhithrogena		137
Choroterpes	52	65
Ephemerella	20	33
Tricorythodes	33	52
Hydropsychidae	104	670
Hydropsyche	78	559
Hydroptila	7	33
Limnophila	20	26
Ceratopogonidae	13	13
Simuliidae larvae	13	267

¹Excluding Oligochaeta and Chironomidae

²Sampling Method: TS = Tall Surber

Carnivorous stoneflies, Claassenia sabuxlosa, Isoperla, and Isogenus occurred in low numbers as did Simuliids and Ceratoponids.

Diversity indices are summarized in Table 3-8-216. Diversities in this region of the White River were lower than the upper White River stations, but higher than the Yellow Creek, Tract and Headwater stations. The richer fauna of mayflies, caddisflies, and stoneflies, the smaller number of taxa showing extreme dominance and the lower density of organisms, accounted for the higher diversity in this region than in the Yellow Creek drainage. Effects of emergence can be seen in comparing April diversity indices to the July - August diversities. The majority of aquatic insects had emerged by July - August.

Macroinvertebrates observed in the first year study in the White River below the confluence with Yellow Creek (Stations 30 - 35) are listed in Table 3-8-217. Seventy-one genera within 32 families were collected. As at other stations on the White River and at stations of the Yellow Creek drainage, the class Insecta was dominant. Oligochaeta were next in abundance. Naididae and Tubificidae were common and small numbers of Enchytraeidae and Lumbriculidae were observed. The aquatic insects generally belonged to the orders Ephemeroptera and Diptera. The Chironomidae ranged from 2.5% of the total fauna in May - June 1975 to 40% in April 1975. Orthocladius, Eukiefferiella, Microtendipes, and Rheotanytarsus, were the most common taxa. Simuliidae were numerous in May - June 1975. Comprising 67% of the total fauna. The Ephemeroptera comprised from 17.8% of the total fauna in May - June 1975 to 41.6% in April 1975. Major genera within the Ephemeroptera as well as other dominant benthos (excluding Chironomidae and Oligochaeta) are summarized in Tables 3-8-218 through 3-8-223.

Ephemerella, Rhithrogena, and Baetis were the most common mayflies. Tricorythodes and Heptagenia were also abundant. Caddisflies were similar to the other White River station fauna; Hydropsyche, Cheumatopsyche were most common, while Hydroptila and Agapetus occurred in low numbers.

Table 3-8-216. Summary of diversity indices for benthic macroinvertebrates collected at the White River Stations at confluence with Yellow Creek during RBOSP Aquatic Baseline Studies from October - November 1974 through August - September 1975.

<u>Station</u>	<u>Shannon Index</u>	<u>Evenness</u>	<u>Richness</u>	<u>Number of Species</u>
October - November 1974				
28	2.53	.54	2.75	25
29	3.41	.72	3.03	27
$\bar{x}$	2.97	.63	2.89	26
December 1974 - January 1975				
*Stations 28 and 29 were frozen at the time of sampling.				
April 1975				
28	2.87	.78	3.42	31
29	3.49	.71	3.44	30
$\bar{x}$	3.68	.75	3.43	15
May - June 1975				
*Stations 28 and 29 were unable to be sampled due to depth, current velocity and type of substrate.				
July - August 1975				
28	2.62	.73	1.68	12
29	1.37	.53	.80	7
$\bar{x}$	2.00	.63	1.24	10
August - September 1975				
28	2.49	.53	3.01	25
29	3.73	.79	3.16	26
$\bar{x}$	3.11	.66	3.09	26
yearly means	2.94	.67	2.66	19

Table 3-8-217. Benthic macroinvertebrate taxa collected in the White River below confluence with Yellow Creek during RBOSP Aquatic Baseline Studies between October - November 1974 and August - September 1975.

NEMATODA

ANNELIDA

Oligochaeta

Haplotaxida

Enchytraeidae

Tubificidae

Limnodrilus sp. 1

Limnodrilus claparedeianus

Limnodrilus hoffmeisteri

Limnodrilus udekemianus

Immatures with capilliform chaetae sp.

Immatures without capilliform chaetae sp.

Naididae

Nais sp.

Nais behningi

Nais elinguis

Pristina sp.

Lumbriculida

Lumbriculidae

ARTHROPODA

Arachnoidea

Acari

Insecta

Collembola

Ephemeroptera

Baetidae

Baetis sp.

Callibaetis sp.

Centroptilum sp.

Dactylobaetis sp.

Pseudocloeon sp.

Heptageniidae

Heptagenia sp.

Rhithrogena sp.

Leptophlebiidae

Paraleptophlebia sp.

Traverella albertana

Choroterpes sp.

Ephemerellidae

Ephemerella sp.

Tricorythidae

Tricorythodes sp.

Table 3-8-217. Continued.

Diptera

Tipulidae

Ormosia sp.

Limnophila sp.

Ceratopogonidae

Chironomidae

Tanypodinae

Pentaneurini sp.

Ablabesmyia sp.

Larsia sp.

Thienemannimyia group sp.

Diamesinae

Monodiamesa sp.

Odontomesa sp.

Potthastia sp.

Orthoclaadiinae

Cricotopus sp.

Cricotopus cricotopus

Cricotopus cricotopus bicinctus

Cricotopus cricotopus trifascia

Eukiefferiella sp.

Microcricotopus sp.

Orthocladus sp.

Paracladius sp.

Parakiefferiella sp.

Paraphaenocladus sp.

Parametriocnemus sp.

Thienemanniella sp.

Smittia sp.

Orthoclaadiinae sp. 1

Orthoclaadiinae sp. 2

Orthoclaadiinae sp. 4

Chironominae

Chironomini sp.

Chironomus sp.

Chironomus sp. group 2

Cryptochironomus sp.

Harnischia sp.

Microtendipes sp.

Paracladopelma sp.

Phaenopsectra phaenopsectra

Polypedilum sp.

Polypedilum fallax group

Polypedilum tripodura group

Stictochironomus sp.

Tanytarsini sp.

Tanytarsus sp.

Table 3-8-217. Continued.

Odonata
 Zygoptera
 Coenagrionidae
 Anisoptera
 Gomphidae
 Ophiogomphus sp.
Plecoptera
 Euholognatha
 Taeniopterygidae
 Brachyptera sp.
 Capniidae
 Systellognatha
 Perlodidae
 Isoperla sp.
 Isoperla fulva
 Isogenus sp.
 Isogenoides sp.
 Perlidae
 Claassenia sabulosa
Hemiptera
 Corixidae
 Trichocorixa sp.
Coleoptera
 Dytiscidae
 Deronectes sp.
 Hydrophilidae
 Elmidae
 Dubiraphia sp.
 Microcylloepus sp.
 Zaitzevia sp.
 Zaitzevia parvula
Trichoptera
 Rhyacophilidae
 Glossosomatinae
 Hydropsychidae
 Hydropsyche sp.
 Cheumatopsyche sp.
 Hydroptilidae
 Hydroptila sp.
 Mayatrachia sp.
 Leptoceridae
 Oecetis sp.
 Brachycentridae
 Brachycentrus sp.
Lepidoptera
 Pyralidae

Table 3-8-217. Continued.

Cladotanytarsus sp.
Paratanytarsus sp.
Rheotanytarsus sp.
Simuliidae
Simulium sp.
Rhagionidae
Atherix variegata
Empididae
Clinocera sp.
Hemerodromia sp.
Dolichopodidae
Hydrophorus sp.

Table 3-3-218. Summary of mean densities of the most abundant benthos¹(macroinvertebrates) at the White River Stations during RBOSP Aquatic Baseline Studies. October - November 1974. (Data from Surber and Ekman samples are expressed as organisms/m²; data from D Frame samples are organisms/sample.)

Taxa	Below Confluence with Yellow Creek					
	Station					
	30	31	32	33	34	35
Sampling Method ²	DF	DF	DF	DF	DF	DF
Baetidae	2	1	21			
Baetis	1	36	9	2	18	7
Heptagenia	1		5	1		
Rhithrogena		4	3	1	162	311
Ephemerella	38	30	5	3	7	23
Tricorythodes	14	7	7	14		1
Plecoptera	2	3	17	1	10	5
Isoagenus			1		8	12
Acanetetus		4			9	6
Hydropsychidae	18	64	113		1	6
Hydropsyche	25	31	72		2	25
Cheumatopsyche	5	1	7			1
Hydroptila	18	4	14	1	1	
Pyralidae	2	16	10			1
Limnophila	1	4	1	1	5	4
Simuliidae larvae	1	2	1		1	2

¹Excluding Oligochaeta and Chironomidae

²Sampling Method: DF = D Frame

Table 3-8-219. Summary of mean densities of the most abundant benthos¹(macroinvertebrates) at the White River Stations during RBOSP Aquatic Baseline Studies, December 1974 - January 1975.² (Data from Surber and Ekman samples are expressed as organisms/m²; data from D Frame samples are organisms/sample.)

<u>Taxa</u>	Below Confluence with Yellow Creek		
	Station		
	<u>33</u>	<u>34</u>	<u>35</u>
Sampling Method ³	<u>DF</u>	<u>DF</u>	<u>DF</u>
Baetidae	8	5	28
Baetis	19	10	28
Rhithrogena	3	3	333
Ephemerella	190	92	156
Tricorythodes	54	9	2
Capniidae	1	3	24
Isoperla	17	1	27
Isogenus			13
Hydropsychidae	49	4	9
Hydropsyche	105	13	40
Cheumatopsyche	17	2	4
Hydroptila	19	12	1
Peralidae	12	4	
Limnophila	3	17	3
Simuliidae larvae	4	5	46

¹Excluding Oligochaeta and Chironomidae

²Stations 30-32 were frozen solid or ice covered during time of sampling.

³Sampling Method: DF = D Frame

Table 3-8-220. Summary of mean densities of the most abundant benthos¹(macroinvertebrates) at the White River Stations during REOSP Aquatic Baseline Studies, April 1975. (Data from Surber and Ekman samples are expressed as organisms/m²; data from D frame samples are organisms/sample.)

Below Confluence with Yellow Creek						
<u>Taxa</u>	<u>Station</u>					
	<u>30</u>	<u>31</u>	<u>32</u>	<u>33</u>	<u>34</u>	<u>35</u>
Sampling Method ²	<u>TS</u>	<u>TS</u>	<u>TS</u>	<u>TS</u>	<u>TS</u>	<u>TS</u>
Nematoda	20	26	7	130	7	65
Acari	39					
Baetidae	7	72	7	20	52	39
Baetis	65	143	59	137	189	52
Rhithrogena		26		78	78	39
Ephemerella	1092	1021	904	1112	761	1014
Tricorythodes	384	33	39		26	20
Isoperla	33	39	7	26	13	39
Microcyllloepus	7		13	7		
Agapetus		20		26	7	52
Hydropsychidae	208	124	39	7	7	7
Hydropsyche	85	254	7	20		33
Hydroptila	182	26				7
Pyralidae	26	20	7			
Limnophila	26	52		72	20	33
Ceratopogonidae	13	33	20	26		

¹Excluding Oligochaeta and Chironomidae

²Sampling Method: TS = Tall Modified Surber

Table 3-8-221. Summary of mean densities of the most abundant benthos¹(macroinvertebrates) at the White River Stations during RBOSP Aquatic Baseline Studies, May - June 1975. (Data from Surber and Ekman samples are expressed as organisms/m²; data from D Frame samples are organisms/sample.)

<u>Taxa</u>	Below Confluence with Yellow Creek					
	<u>30</u>		<u>31</u>		<u>32</u>	
Sampling Method ²	<u>TS</u>	<u>TS</u>	<u>DF</u>	<u>DF</u>	<u>DF</u>	<u>DF</u>
Nematoda	7		1			
Acari	7					
Baetidae	20	20				1
Baetis	46	85			2	9
Rhithrogena	13	20	1			
Ephemerella	52	52	8	5	4	149
Plecoptera		7				12
Isoperla		20				1
Hydropsychidae	7					1
Hydropsyche	39	13	1	1	1	3
Hydroptila		7				
Ormosia	7	7				
Limnophila	7		1	1	1	
Ceratopogonidae	13	7				
Simuliidae larvae	1346	52				2
Hydrophorus		7				

¹Excluding Oligochaeta and Chironomidae

²Sampling Method: TS = Tall Modified Surber
DF = D Frame

Table 3-8-222. Summary of mean densities of the most abundant benthos¹ (macroinvertebrates) at the White River Stations during RBOSP Aquatic Baseline Studies, July - August 1975. (Data from Surber and Ekman samples are expressed as organisms/m²; data from D Frame samples are organisms/sample.)

Below Confluence with Yellow Creek		Station					
<u>Taxa</u>		<u>30</u>	<u>31</u>	<u>32</u>	<u>33</u>	<u>34</u>	<u>35</u>
	Sampling Method ²	<u>TS</u>	<u>DF</u>	<u>TS</u>	<u>TS</u>	<u>TS</u>	<u>TS</u>
Nematoda		20	2		7		39
Acari		7		20		7	7
Collembola		13					
Rhithrogena		7	1			39	52
Ephemerella		20	1	20	13		
Tricorythodes					7		7
Hydropsychidae							
Hydropsyche		13	1		7		
Cheumatopsyche				7			
Limnophila		7			20	7	

¹Excluding Oligochaeta and Chironomidae

²Sampling Method: TS = Tall Modified Surber
DF = D Frame

Table 3-8-223. Summary of mean densities of the most abundant benthos¹(macroinvertebrates) at the White River Stations during RBOSP Aquatic Baseline Studies, August - September 1975. (Data from Surber and Ekman samples are expressed as organisms/m²; data from D Frame samples are organisms/sample.)

Below Confluence with Yellow Creek						
Taxa	Station					
	30	31	32	33	34	35
Sampling Method ²	TS	DF	TS	TS	TS	TS
Nematoda	7	52	39	13	7	13
Baetidae	13	33	39	7	39	514
Baetis	7	39	52		20	130
Heptagenia	20	20	46	7		
Rhithrogena	7	33	33		2243	1177
Choroterpes	7	46	78	59		
Ephemerella	52	65	65	111	39	117
Tricorythodes	13	72	85	143	7	7
Plecoptera		7	7		78	85
Agapetus		39				39
Hydropsychidae	787	1586	611	137	46	481
Hydropsyche	390	943	325	163	221	592
Hydroptila	20	26	26	20	7	
Limnophila	39	46	26	143	124	163
Simuliidae larvae	7	13	26		52	208

¹Excluding Oligochaeta and Chironomidae

²Sampling Method: DF = D Frame
TS = Tall Modified Surber

Isoperla was the most common stonefly in this part of the White River. Isogenus and Capniidae were observed on several of the collection dates.

Species diversity indices for the White River stations (30 - 35) below the confluence with Yellow Creek are summarized in Table 3-8-224. The average number of species collected at these stations was lower than that observed at the upper stations. Effect of emergence can be seen by observing the low indices recorded in July - August 1975. By August - September 1975, recruitment by eclosion (egg hatching) had started.

5. Discussion - The organisms most often encountered throughout the Yellow Creek drainage were the Diptera (Chironomidae, Simuliidae, Ceratopogonidae, Tipulidae and Anthomyiidae), Oligochaeta, Ephemeroptera (Baetis), Plecoptera (Capnia), Trichoptera (Hydroptilidae and Hesperophylax). Odonata (Caenagrionidae), and Coleoptera (Dytiscidae). Organisms occasionally collected in the Yellow Creek drainage were Ephemeroptera (Callibaetis and Caenis), Diptera (Psychodidae, Stratiomyidae, Tabanidae and Empididae), Gastropoda, Hirudinea (Helobdella stagnalis) and Hyallela azteca. Benthic invertebrates collected rarely in the Yellow Creek drainage were Ephemeroptera (Epeorus and Tricorythodes), Odonata (Aeshnidae and Gomphidae), Plecoptera (Perlodidae), Hemiptera (Corixidae, Notonectidae and Gerridae), Coleoptera, Gyrinidae, Haliplidae, Hydraenidae, Hydrophilidae, Elmidae and Dryopidae), Trichoptera (Hydropsyche and Grammotaulius), Diptera (Thaumaleidae and Dixidae), Hydra and Collembola.

In the White River, the Ephemeroptera, Diptera and Oligochaeta were the dominant groups. There was a greater diversity in the mayflies, caddisflies and stoneflies in the White River than in any of the other sampling areas. Ephemeroptera included primarily Ephemerella, Rhithrogena and Baetis. Moderate numbers of Heptagenia and Tricorythodes were observed, while Ameletus, Lachlania, Centroptilum, Dactylobactis, Paraleptophlebia, Caenis, Brachycercus and Ephoron were rare. Also in the White River, the Chironomidae were generally less abundant than in areas of the Yellow Creek drainage.

Table 3-8-224. Summary of diversity indices for benthic macroinvertebrates collected at the White River Stations below confluence with Yellow Creek during RBOSP Aquatic Baseline Studies from October - November 1974 through August - September 1975.

<u>Station</u>	<u>Shannon Index</u>	<u>Evenness</u>	<u>Richness</u>	<u>Number of Species</u>
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October - November 1974

*Stations 30-35 were not established at this collection date.

December 1974 - January 1975

*Stations 30-32 were frozen at the time of sampling.

*Stations 33-35 were unable to be samllled due to depth, current velocity, and type of substrate.

April 1975

30	3.19	.71	2.58	23
31	3.12	.72	2.40	20
32	3.08	.71	2.32	20
33	3.08	.73	2.24	19
34	2.18	.70	1.54	13
35	2.79	.67	2.26	18
$\bar{x}$	2.91	.71	2.22	19

May - June 1975

30	1.61	.50	1.19	9
31	2.69	.89	1.26	9
$\bar{x}$	2.15	.70	1.23	9

*Stations 32-35 were unable to be sampled due to depth, current velocity, and type of sbustrate.

July - August 1975

30	2.28	.98	.90	5
32	1.79	.93	.64	4
33	1.91	.97	.65	4
34	1.57	.86	.55	4
35	1.86	.89	.65	4
$\bar{x}$	1.88	.93	.68	4

*Station 31 was unable to be sampled due to depth, current velocity, and type of substrate.

Table 3-8-224. Continued.

<u>Station</u>	<u>Shannon Index</u>	<u>Evenness</u>	<u>Richness</u>	<u>Number of Species</u>
August - September 1975				
30	3.24	.73	2.94	23
31	3.03	.65	2.96	25
32	3.62	.77	3.14	26
33	3.01	.65	3.05	26
34	1.62	.41	1.75	15
35	3.35	.75	2.51	22
$\bar{x}$	2.98	.66	2.73	23
yearly means	2.48	.75	1.72	14

The caddisflies most often encountered were the Hydropsychidae. Taxa of Hydroptilidae and Glossosomatinae were occasionally observed, while Oecetis and Brachycentrus were rare. The most common Plecoptera were Iso-genoides, Isoperla and Claassenia. Brachyptera and Capniidae were occasionally collected. Small numbers of organisms belonging to other insect groups were also encountered in the White River; the other insect groups included: Odonata (Ophiogomphus), Lepidoptera (Pyralidae), Acari, Collembola, Hemiptera (Corixidae), Coleoptera (Elmidae) and Diptera (Ceratopogonidae) Tipulidae, Simuliidae (Rhagionidae and Empididae).

The Oligochaeta observed in all sampling areas were represented by seven families: Tubificidae, Naididae, Enchytraeidae, Lumbriculidae, Haplotaxidae, Lumbricidae and the Aeolstomotidae.

In general, the Naididae and Enchytraeidae were abundant in the headwater and tract regions, whereas the Tubificidae and Naididae were abundant in Yellow Creek and the White River. The family Naididae, which was generally abundant throughout the study area, has been characterized by Brinkhurst (1966a) as occurring in rapidly flowing streams. Howmiller and Beeton (1970) reported that these small, fragile worms occasionally pass through the mesh sieves used in benthic surveys and therefore, not all potential species are reported. The family Enchytraeidae was most common in the tract region. According to Brinkhurst (1953), most species belonging to this family are terrestrial in habit; this fact suggests that their abundance in the tract region can probably be attributed to their ability to survive during the period in which the streams remain dry. The Tubificidae, long characterized as being tolerant of environmental stress (Brinkhurst and Jamieson, 1971) were abundant at Station 5 of the headwater region and in Yellow Creek and the White River. Tubificids are known to feed primarily upon bacteria associated with organic matter (Brinkhurst et al., 1972). The relatively great amount of aquatic vegetation suggests that there is abundant organic matter available for bacterial decomposition which, in turn, provides abundant nutrients for Tubificids. However, the reasons for the abundance of Tubificids in other regions are unknown. The family Lumbriculidae occurred

in the tract region, in Yellow Creek, and in the White River. This group has previously been characterized as occurring in stony trout streams. In the present study, the family Lumbriculidae was represented by specimens possessing a thick muscular body wall and two setae per bundle indicating that these specimens may belong to the genus Sparoanophilus which has been reported as the most common limnetic megadrile in North America (Brinkhurst and Jamieson, 1971). The family Haplotaxidae occurred only in the headwater region; these organisms have been reported primarily from underground waters and in areas where ground water seepages enter a stream (Brinkhurst, 1966a, b). A single specimen of the family Aeolostomatidae was collected during the present studies. These worms are fragile, less than 2 mm (0.08 inches) long and are not generally found in benthic collections unless special attention is given to them (Brinkhurst and Cook, 1974).

The assemblage of macroinvertebrates in the Yellow Creek drainage was represented by a diverse number of taxa which are well adapted to the conditions of the biotic environment. This was particularly true for many of the taxa which occur in the White River. Dorso-ventral flattening, for example, was common in many mayflies and stoneflies. Rhithrogena, Heptagenia, Choroterpes, Traverella albertana of the mayflies and Claassenia sabulosa, a stonefly, have this structural adaptation. With this adaptation, these organisms can remain within the Prandtl or boundary layer (Jaag and Ambhl, 1964) and move about actively without being dislodged from the substrate. In the genus Rhithrogena, the first and seventh pairs of gills have been modified to increase the area of marginal contact. According to Hynes (1970) this reduces possibility of the waters flowing under the nymph. Other mayflies, such as Caenis, Tricorythodes and Brachycercus, have the the second pair of gills modified into opercula-like covers. These taxa live on highly silted areas and the modified gills protect the other gill pairs on segments 3 to 6. The extremely abundant blackflies are equipped with a rear circlet of hooks which attach under silk lines (produced by the salivary glands) that are fastened to the substrates. The proleg of simuliids also have a circlet of hooks to aid in movement.

Many of the adaptations of aquatic insects in the Yellow Creek drainage and in the White River were related to their food gathering habits. All feeding types were represented in the fauna of the drainage. While many of the taxa were filter or net feeders, others were detritivores, which aid in the breakdown of allochthonous and autochthonous materials in the system. Many of the taxa were opportunistic feeders and were therefore difficult to classify.

The benthic fauna at headwater Stations 1 - 4 was similar but this fauna differed from that of headwater Station 5. Physico-chemical factors help explain this difference. Station 5 was located downstream from a weed choked (sedges and watercress) spring area while Stations 1 - 4 were typified by cool springs with relatively little macrophytic growth. The stream beds at Stations 1 - 4 were composed of loose aggregations of sand, gravel and shale pieces covered with periphyton. The substrate at Station 5 was thoroughly compacted gravel with the periphyton bound in a small incrustation. The number of taxa and the density of organisms was generally higher at Station 5 than at the other four stations. Available food supply, substrate type and differences in dissolved solids (higher at Station 5) were the probable reasons for the differences in community structure.

The aquatic insects of the headwater stations have univoltine (one generation/year) or multivoltine (more than one generation/year) life cycles. The aquatic insects which take two or three years for development have not been successful in the invasion of the headwater stations. The Ephemeroptera, (composed primarily of Baetis) reached peak abundance at Station 4 in December 1974 - January 1975. By May - June 1975, the densities had decreased dramatically, most likely due to emergence of the insects. Emergence of the Capnia spp. occurred in late winter and early spring. These stoneflies have univoltine life cycles as do the few trichopteran genera found in these headwaters. Because of the occurrence of many genera of dipterans, their emergence patterns were difficult to define. The Simuliidae (blackflies) have been described in the literature as possibly having multivoltine life cycles (Hynes, 1970).

Tract stations (6 - 18) tended toward more temporary flow than other stations within the Yellow Creek drainage. Stations 10, 11 and 16 have been dry throughout the study. These stations were located in large gulches, which were wet during periods of rain and heavy runoff from snowmelt. Stations 6, 12, 15 and 18 were flowing only once during the sampling periods. Station 17 was flowing on two collection dates. The fauna of these intermittent stations was represented by species with rapid life cycles, and species which can easily invade new waters by various means. Thus, the adults may deposit eggs, or the immature stages may drift downstream or actively move upstream. During drought periods the fauna may burrow into the loose substrates (hyporheic zone) and exist in a dormant stage until conditions improve.

The substrates at tract Stations 6 through 13, and 14, 17 and 18 were generally similar and were composed of gravel, sand and silt. Because the substrates and chemical conditions at these stations were generally similar, these stations resembled headwater Stations 1 through 4 more than any other group of stations. While the densities of certain taxa remained high, the number of species and richness and diversity indices were lower at the tract stations than at the headwater stations. Drought conditions at the tract stations are believed to be one of the major reasons for this. Station 14 was a pond area partially filled with the aquatic macrophyte Zannichellia palustris. The components of the benthos at this site were Corixidae, Dytiscidae, certain Chironomidae such as Micropsectra, Ceratogonidae and Anthomyiidae; Naididae and Enchytraeidae were the common aquatic worms. Seasonal patterns of the macroinvertebrates at the tract stations were very similar to those described for the headwater Stations 1 through 4.

Lower Yellow Creek (Stations 19 - 22) was characterized by high dissolved solids. Station 19 had slightly lower specific conductivity and alkalinity than Stations 20 - 22. The findings of the present study at Station 20

are comparable with those of Pennak (1974). However, his statement that "three of the four common orders of stream insects (mayflies, caddisflies and stoneflies) are absent from the Yellow Creek, undoubtedly as a result of exceptionally high salt content of this water" is not completely substantiated. It is true that the abundance of these common stream insects was in extremely low numbers in the location that Pennak sampled over a corresponding time period. However, upstream at Station 19 where dissolved solids were slightly lower (but nevertheless extremely high), these common stream orders occurred in moderate numbers at certain times of the year. Station 19 was located at a pool which is choked with Chara. The difference in substrate and the availability of food, and consistently cooler water temperatures at Station 19 were probably some of the reasons for the higher number of species and greater species richness here than at the other Yellow Creek stations.

Densities of certain taxa were extremely high at the Yellow Creek stations. However, species diversity indices for these stations were quite low due to dominance of a few taxa. High salt content was certainly one of the limiting factors in this creek.

The White River was characterized by a rubble bottom with many interstitial areas which were available as habitat for benthic organisms. Densities of macroinvertebrates were lower in the White River than in Yellow Creek drainage. However, in the upper White River stations (23 - 27), the diversity index was highest. This was due to the increased numbers of genera of mayflies, caddisflies and stoneflies, and to the fact that there was less dominance by a few taxa. The insects were abundant in the White River and the major emergence occurred in late spring and early summer. Monthly diversity indices for the White River stations indicated significant decreases in the Shannon-Wiener Index, richness and number of species in the July - August samplings.

Stations 28 and 29 were located in a side channel of the White River at the confluence with Yellow Creek. Station 28 was located directly off the mouth of Yellow Creek, and Station 29 was approximately 100 m (328 ft) downstream. Station 28 was unique among the White River stations in that the substrate was compacted gravel and sand, and flow was slow enough during low water periods to allow the area to silt over. This substrate change was reflected in the relatively low densities of Ephemeroptera, Plecoptera, and Trichoptera compared to the other White River stations. A seasonal trend at Stations 28 and 29 was suggested by the occurrence of Ephemeroptera, Plecoptera and Trichoptera. Whether this was due to emergence patterns or the change in habitat is not clear. It is possible that the peak emergence occurred just prior to the periods of low flow and the area was recolonized, through drift, after it had been cleared of silt by higher flows later in the year.

The percentage of Oligochaeta was higher at Stations 28 and 29 than at the other White River stations. This was likely to the higher amounts of silt available in this area.

Physically, the lower White River stations (30 - 35) were similar to the upper White River stations (23 - 27) except that the substrate was less consolidated at the lower stations. The percentage of Oligochaeta was noticeably less at these lower stations. This was likely due to the larger rocks and rubble having more surface area exposed to the current. There was thus a constant shifting of the small particles which tended to inhibit burrowing organisms. In the White River stations, there was a greater diversity of mayflies, caddisflies and stoneflies than in Yellow Creek or at the tract and headwater stations. Diversity indices provided clues as to the life cycles and emergence periods of this fauna. The major reason for increased diversity in the White River was the additional habitats which were available.

During the summer growing periods, the periphyton was bound in a marl matrix which may have caused some problems for strictly herbivorous organisms

Most of the dominant organisms (Ephemerella, Hydropsychidae, Chironomidae, Oligochaeta, and Plecoptera) probably avoided this problem by being omnivores, detritivores, filter feeders or predators (Berner, 1959; Ross, 1944; Pennak, 1953).

In summary, the headwater stations were represented by a moderately diverse benthic community which maintained high densities of organisms throughout the year. Diptera were abundant in the headwater stations as well as in the tract and Yellow Creek stations. However, diversities were lower at the tract and Yellow Creek stations. Fewer genera were found here, and certain taxa such as the Simuliidae were extremely abundant.

The diversity of the benthic community of the White River was higher than that observed in any of the other study areas. Benthic densities were moderate throughout most of the year. The Shannon Index, the number of species, and species richness were highest in the region above the confluence with Yellow Creek. It appears that this is related more to substrate type and sampling location rather than to the influence of Yellow Creek since the mayfly, caddisfly and stonefly populations were comparable above and below the confluence with Yellow Creek.

Benthic macroinvertebrates were the dominant organisms at the primary and secondary consumer levels in most waters of the study area, and, as such should serve to indicate trends at these levels during the monitoring phase.

Stations 28 and 29 were located in a side channel of the White River at the confluence with Yellow Creek. Station 28 was located directly off the mouth of Yellow Creek, and Station 29 was approximately 100 m (328 ft) downstream. Station 28 was unique among the White River stations in that the substrate was compacted gravel and sand, and flow was slow enough during low water periods to allow the area to silt over. This substrate change was reflected in the relatively low densities of Ephemeroptera, Plecoptera, and Trichoptera compared to the other White River stations. A seasonal trend at Stations 28 and 29 was suggested by the occurrence of Ephemeroptera, Plecoptera and Trichoptera. Whether this was due to emergence patterns or the change in habitat is not clear. It is possible that the peak emergence occurred just prior to the periods of low flow and the area was recolonized, through drift, after it had been cleared of silt by higher flows later in the year.

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Benthic macroinvertebrates were the dominant organisms at the primary and secondary consumer levels in most waters of the study area, and, as such should serve to indicate trends at these levels during the monitoring phase.

E. Macrophytes

1. Objectives - The objectives of this aspect of the RBOSP Aquatic Baseline Studies are to identify and enumerate aquatic macrophytes, to determine relative abundance of each species and to describe the major beds of macrophytes at each station.

2. Methods - Macrophyte data are collected using a random transect line system (Jessen and Lound, 1962). Samples are collected simultaneously with the field collection of other biological data.

Samples were taken along randomly chosen transects that cross the streams at each station. All plants within 0.5 m (1.6 ft) upstream and downstream of the transect line were identified and representative plants were maintained as voucher specimens.

The areas covered by major beds of macrophytes upstream and downstream of each site were measured with a tape while wading in the stream or pond. The major species in each bed was determined and relative abundance of those species was noted. The relative abundance of macrophytes at various sampling stations is provided in Table 3-8-225.

Voucher specimens of the macrophytes were processed and stored in the Ecological Sciences Division herbarium. The scientific and colloquial names of macrophytes encountered on Tract C-a are included in Table 3-8-226. Taxonomic references are listed in the literature section at the end of Section 8.2.

3. Literature Review - No literature specific to the site is available. General works which contain information pertinent to the macrophytes of Colorado include those of Harrington (1964) and the U. S. Department of the Interior (1973).

Table 3-8-225. Relative abundance of macrophytes at aquatic sampling stations during RBOSP Aquatic Baseline Studies, October-November 1974 to August-September 1975.

Station	Date					
	Oct.-Nov.	Dec.-Jan.	April	May-June	July-Aug.	Aug.-Sept.
1				Watercress-1 ^(a)		American Speedwell-1
2			Watercress		American Speedwell-1 Shore crowfoot-2	American Speedwell-1
3					American Speedwell-2	Shore Crowfoot-2
4						American Speedwell-1
5		Unknown Sedge		American Speedwell-3 Shore Crowfoot- Watercress-1 Manna Grass-3	Horned Pondweed Shore Crowfoot-1 Watercress- Water Crowfoot-2	American Speedwell-2 Shore Crowfoot-4 Watercress-2
7						Shore Crowfoot-2
8		Pondweed Watercress	Unknown Grass Watercress	Unknown Grass-3 Watercress-2		
9	Horned Pondweed					Shore Crowfoot-1
10	Watercress Mares Tail					
14	Stonewort		Horned Pondweed	Horned Pondweed-3	Horned Pondweed-4	Horned Pondweed-5
19			Stonewort (dead)	Stonewort-5		Stonewort-5 Shore Crowfoot-2 Horned Pondweed-2 Three-square
20				Horned Pondweed-4		Horned Pondweed-4 Three-square-3 Bayonet-grass-3
21						Horned Pondweed-4 Three-square-3 Bayonet-grass-3

(a) Number indicates relative abundance of plants as provided in Jessen and Lound, 1962.

5 (most abundant)	2 scattered growth
4 heavy growth	1 (least abundant)
3 moderate growth	

3-8-634

Table 3-8-226. Aquatic macrophytes observed during RBOSP Aquatic Baseline Studies, October 1974-September 1975.

<u>Scientific Name</u> ^(a)	<u>Colloquial Name</u>
<u>Chara kieneri</u>	Stonewort
<u>Glyceria sp.</u>	Manna Grass
<u>Hippuris vulgaris</u>	Mare's-tail
<u>Potamogeton cf. foliosus</u>	Pondweed
<u>Ranunculus cymbalaria</u>	Shore Crowfoot
<u>R. natans</u>	Water Crowfoot
<u>Rorippa nasturtium-aquaticum</u>	Watercress
<u>Scirpus americanus</u>	Three-square
<u>S. paludosus</u>	Bayonet-grass
<u>Veronica americana</u>	American Speedwell
<u>Zannichellia palustris</u>	Horned Pondweed

(a) Nomenclature according to Harrington, H.D. 1964.

4. Data Summary

a. Results - During October-November 1974, horned pondweed (Zannichellia palustris) was found growing in 0.6 m (2.0 ft) of water near the shore of the pond at Station 14. At Station 5, mare's-tail (Hippurus vulgaris) was growing in 0.6 m (2.0 ft) of water near the edge of a pond; in the narrow, shallow, fast flowing stream below the pond, watercress (Rorippa nasturtium-aquaticum) was also found. At Station 19, stonewort (Chara cf. kieneri) formed an extensive mat on the bottom of the pond.

During December 1974-January 1975, pondweed (Potamogeton cf. foliosus) and watercress were found at Station 8. On the upstream and downstream sides of the random transect crossing the stream at Station 8, pondweed occupied an area of 0.6 m² (6.5 ft²) and approximately 1 m² (1 ft²), respectively. At Station 5, unidentified sedges covered the bottom of the stream for 30 to 60 m (98 to 197 ft) both upstream and downstream from the transect. At the sampling transect, sedges occupied an area of 6 m (20 ft) across the stream and approximately 1 meter (3 ft) on both the upstream and downstream sides of the transect.

Macrophytes were observed at Stations 2, 8 and 19, during April 1975. At Station 2, patches of watercress were scattered along the stream, with the nearest patch (0.04 m², 0.43 ft²) occurring within 0.5 m (3 ft) of the transect. Two slightly larger patches were located within 15 m (49 ft) downstream from the transect. In a pool 6.6 m² (71 ft²) at Station 8, a grass was found along one side, with watercress occurring in small patches within the mats of grass. At Station 19, scattered mats of dead stonewort were observed.

During May-June 1975, macrophytes were observed at Stations 1, 5, 8, 14, 19 and 20. Isolated small patches of watercress were found at Stations 1 and 5. This plant was found scattered throughout a large bed of grass (possibly manna grass, Glyceria sp.) at Station 8. Occurring along with watercress at Station 5, were American speedwell (Veronica americana),

manilla grass and shore crowfoot (Ranunculus cymbalaria). Horned pondweed was of moderate to heavy abundance at Stations 14 and 20, forming a 30 m² (323 ft²) mat along the bottom of the ponds at each station. Stonewort formed an extensive mat in the pond at Station 19.

Macrophytes were observed at four stations during the July-August sampling, including Stations 2, 3, 5, and 14. Three patches of American speedwell, each 0.1 m² (0.9 ft²) and scattered patches of shore crowfoot were observed at Station 2.

American speedwell also occurred in scattered patches at Station 3. At Station 5, one patch (0.3 m², 3.2 ft²) of shore crowfoot and scattered plants of water crowfoot (Ranunculus natans) were found growing in the marsh area. Also at Station 5, an area of horned pondweed 0.4 m² (4.3 ft²) covered the bottom of the stream. Approximately 7 m (23 ft) downstream from the transect at Station 5, an extensive growth of watercress covered the stream bottom. At Station 14 a 150 m² (1,614 ft²) of horned pondweed was observed.

In August-September 1975, macrophytes were found at Stations 1, 2, 3, 4, 7, 9, 14, 19, 20 and 21. At Stations 1, 2 and 4, American speedwell was present. Scattered plants of this species were also found at Station 5, along with watercress. Providing a heavy cover at Station 5 was shore crowfoot. Scattered specimens of shore crowfoot were found at Stations 3, 7, 9 and 19. At Station 19 this species occurred with scattered individuals of three-square (Scirpus americanus) and horned pondweed. Stonewort formed an extensive mat on the pond bottom. Horned pondweed formed a 150 m² (1,614 ft²) patch at Station 14 and provided heavy cover at Stations 20 and 21. Both three-square and Bayonet-grass (Scirpus paludosus) provided moderate cover at Stations 20 and 21.

5. Discussion - In general, aquatic macrophytes did not comprise a major component of aquatic ecosystems on or near Tract C-a. The aquatic macrophytes which were on or near Tract C-a are emergents and/or are plants

typical of moist to wet alkaline habitats. Plants more typical of alkaline ponds include bayonet-grass, stonewort, shore crowfoot and horned pondweed. Although many of the other species may occur in wet alkaline habitats, they are more cosmopolitan and occur in a variety of paludal habitats (i.e., American speedwell, three-square and manna grass). These three species range throughout most of the United States.

F. Fish

1. Objectives - The objective of this study is to describe the fish community of the site by collection and identification of fishes; pertinent meristic measurements; and observations of growth, spawning and condition.

2. Methods

a. Field Sampling - White River - The primary method of sampling in the White River was electrofishing with a 220 volt, 1,000 watt AC/DC electrofishing unit. The alternator and electrofishing unit were placed on shore and connected to two hand-held probes (positive and negative) at the ends of 15 meters (50 ft) lengths of waterproof cable (two positive probes were used at some stations in April). AC voltage was used in October 1974 and DC voltage at all other times.

Approximately 100 ft sections of stream were sampled. The probes were moved upstream where possible, and sometimes downstream. Stunned fish were picked up with dip nets. Early attempts at holding seines below the probes while moving downstream were unsuccessful due to the extreme difficulty of holding the seines against the current. Each station was sampled twice. Back channel areas at Stations 23, 27-29, and 33 were blocked off during sampling with 0.64 cm (0.25 inch) square mesh seines during low flow periods in October - November 1974, and October, April, July - August, and August - September 1975.

b. Field Sampling - Yellow Creek - Yellow Creek Stations 20 through 22 were completely blocked off with seines. When sufficient water was flowing, two seine hauls were made through the 30 m (100 ft) sections in an upstream direction. During summer and fall low flow periods, the stations were sampled in duplicate with dip nets.

c. Sample Processing (Field) - Captured fish were held in 0.317 cm (0.125 inch) mesh holding nets (large fish) or buckets of water (small fish) until one or more stations had been sampled. The larger fish were then weighed to the nearest gram and measured (total length) to the nearest

millimeter. Stomachs were excised from some of the larger fish and placed in individual jars in 10% formalin. Some smaller fish were preserved whole in 10% formalin for laboratory processing. Scales were taken from appropriate species and placed in individual envelopes on which all pertinent data were recorded. Certain larger fishes were preserved whole for inclusion in a voucher collection.

d. Sample Processing (Laboratory) - Fishes returned to the laboratory were weighed to the nearest 0.1 g and measured to the nearest mm. Identifications were confirmed with the aid of taxonomic keys that included Beckman (1952), Smith (1966), and Minckley (1973).

Fish stomachs brought back from the field and those taken from smaller fish in the laboratory were cut open and the contents were examined under a dissecting microscope. The total number of each food item was obtained, either by a complete count, a sub-sample count, or, for numerous small organisms, an eye estimate, and recorded separately for each fish. Identifications of food items were made to the lowest possible taxonomic level.

Fish scales were stained with Alizarin Red S, permanently mounted on glass slides, and examined under either a microprojector or a dissecting microscope. The criteria of Tesch (1968) were used to determine the presence of annuli (year marks). Number of annuli and distances from each mark to the scale focus were recorded.

Length-frequency analyses were done on flannelmouth suckers, mottled sculpin, and speckled dace by the method described in Lagler (1956).

Condition factors (K) were computed from the formula given by Carlander (1969):

$$K = \frac{W 10^5}{L^3}$$

where W = weight in grams

L = total length in millimeters

and 10^5 = a factor to bring K near unity

3. Literature Review - Few fishery investigations have been made on or near Tract C-a. Pettus (undated) and Everhart and May (1973) reported the results of fish studies of Piceance Creek, approximately 16 km (10 miles) upstream from the RBOSP White River sampling area. Both of these previous studies included several stations in the White River above and below Yellow Creek, and one (Everhart and May, 1973) included a station in lower Yellow Creek. These earlier investigations of the White River were of relatively short duration and low intensity compared with present RBOSP aquatic baseline studies.

All fish species captured in the White River during the previous studies were also captured during the present RBOSP study with three exceptions: white sucker (Catostomus commersoni), bonytail (Gila elegans) and Colorado squawfish (Ptychocheilus lucius). The latter two are of particular note because of their scarcity. The bonytail is considered quite rare in the Colorado River Basin (Holden and Stalnaker, 1975b) and the Colorado squawfish is listed by the U.S. Department of Interior (1974) as nationally endangered. These and the other species captured are discussed in more detail in the section on fish community composition.

A number of studies which have been conducted in other areas of the Upper Colorado River Basin supplement the meager site-specific literature. In Utah, McDonald and Dotson (1960) reported on pre-impoundment surveys at the Flaming Gorge and Glen Canyon Dam sites on the Green and Colorado rivers, respectively. Channel catfish and flannelmouth suckers were most abundant in the mainstream areas of the Glen Canyon site. Speckled dace were most abundant in tributaries. At the Flaming Gorge area of the Green River, flannelmouth suckers and "bonytail"* were most abundant in the main river. Speckled dace, red-side shiner (Richardsonius balteatus), mottled sculpin and rainbow trout were abundant in tributaries. Some life history information was presented by McDonald and Dotson (1960) for several species.

*The "bonytail" captured may have included both the roundtail chub, Gila robusta and bonytail, G. elegans. This study was done when all "bonytail" forms were listed as a single species, Gila robusta, with several sub-species.

Miller (1964) discussed the fishes of the Green and Yampa rivers in Dinosaur National Monument in northwestern Colorado and northeastern Utah. The fish community composition was similar to that found in the RBOSP studies of the White River, with the exception of bonytail, Colorado squawfish, humpback chub (Gila cypha), and the introduced redbase shiner.

Vanicek et al. (1970) reported on Green River fishes following the closing of Flaming Gorge Dam. A major ecological change occurred below the dam following closing, due to changes in seasonal flows and temperatures. Native fishes were largely replaced by rainbow trout in the first 42 km (26 mi) downstream and were affected for at least 104 km (65 mi) downstream.

The Dolores and Yampa rivers were studied by Holden and Stalnaker (1975a). The most common species were flannelmouth sucker and speckled dace in the Dolores River, and flannelmouth and bluehead suckers, speckled dace, round-tail chub, and redbase shiner in the Yampa River.

Holden and Stalnaker (1975b) reported on the "distribution and abundance of mainstream fishes of the middle and upper Colorado River Basins, 1967-1973." The native flannelmouth and bluehead suckers were the dominant species. Four rare or endangered species were reported: Colorado squawfish, bonytail, humpback chub and humpback sucker (Xyrauchen texanus). The authors attributed the decline of native fishes to high dams and the presence of exotic (non-native) fishes (exotic fish species outnumbered natives 19 to 10).

4. Data Summary and Discussion

a. Fish Community Composition

1) General - A total of 15 fish species and one hybrid form were captured in the White River and Yellow Creek during RBOSP aquatic studies. The most common species were flannelmouth sucker, bluehead sucker, speckled dace, fathead minnow, and mottled sculpin (Table 3-8-227). The small number of species captured is similar to findings of other studies. Holden and Stalnaker (1975b) reported 29 species in the Middle and Upper

Table 3-8-227. List of fish species and numbers captured at the RBOSP site during the period October 1974 through September 1975.

Common Name ¹	Scientific Name ¹	Numbers Captured					Total
		October 1974	April 1975	June 1975	July 1975	September 1975	
Cutthroat trout	<u>Salmo clarki</u>	-	-	1	-	-	1
Brown trout	<u>Salmo trutta</u>	1	1	-	-	1	3
Rainbow trout	<u>Salmo gairdneri</u>	1	4	-	-	-	5
Mountain whitefish	<u>Prosopium williamsont</u>	7	2	-	-	8	17
Roundtail chub	<u>Gila robusta</u>	-	1	10	5	5	21
Speckled dace	<u>Rhinichthys osculus</u>	126	21	238	48	392	825
Fathead minnow	<u>Pimephales promelas</u>	90	10	54	5	150	309
Red shiner	<u>Notropis lutrensis</u>	-	-	-	1	10	11
Carp	<u>Cyprinus carpio</u>	-	-	1	3	23	27
Flannelmouth sucker	<u>Catostomus latipinnis</u>	58	66	128	109	162	523
Bluehead sucker	<u>Catostomus discobolus</u>	26	14	38	17	64	159
Mountain sucker	<u>Catostomus platyrhynchus</u>	-	-	-	1	1	2
Channel catfish	<u>Ictalurus punctatus</u>	-	-	-	-	1	1
Black bullhead	<u>Ictalurus melas</u>	-	-	-	1	-	1
Mottled sculpin	<u>Cottus bairdi</u>	233	28	11	11	130	413
Flannelmouth X Bluehead	<u>Catostomus latipinnis</u> X <u>C. discobolus</u>	-	1	-	-	2	3

¹Common and scientific names after Bailey, et al. 1970

Colorado River Basins. McDonald and Dotson (1960) reported 17 species in the Glen Canyon area of the Colorado and San Juan Rivers and 16 species in the Flaming Gorge area of the Green River. In the White River, Pettus (undated) reported eight species and Everhart and May (1973) reported 12 species.

The fish fauna west of the Rocky Mountains and north of Mexico was characterized as "depauperate" by Miller (1961). Approximately 100 species are known from the region. Behnke (unpublished manuscript) listed 27 species as native to the Colorado River Basin. "Species diversity" is indeed low when compared to the Illinois River (92 species) or the Black River, Missouri (68 species) (Hynes, 1970).

Introduced species have increased tremendously in the western United States in the last 100 yrs. Minckley (1973) pointed out that the original eight or nine families of fishes native to Arizona have increased to 22, or almost one-half of the number of strictly freshwater fish families recorded in the entire U.S. The results can be seen in data from various studies in the Middle and Upper Colorado River Basin:

<u>Source</u>	<u>Number Native Species</u>	<u>Number Introduced Species</u>
Holden and Stalnaker (1975a)	10	19
Vanicek, et al. (1970)	9	12
McDonald and Dotson (1960)	6	11
McDonald and Dotson (1960)	9	7
Miller (1964)	8	7
Everhart and May (1973)	7	5
Pettus (undated)	5	3
Present RBOSP Study	8	7

2) Family salmonidae - Cutthroat trout, Salmo clarki (native) - One adult specimen was captured at Station 29 near the mouth of Yellow Creek in June 1975. The single occurrence of this species, and also the low numbers of brown and rainbow trout, is most probably due to marginal habitat conditions, i.e., high silt load and elevated summer water temperatures.

Although cutthroat trout are native to the Upper Colorado River, the original native subspecies, Salmo clarki pleuriticus, is very rare (Behnke, unpublished manuscript). The specimen captured in the White River was most probably Salmo clarki lewisi, a widely introduced form.

Brown trout, Salmo trutta (introduced) - Three brown trout were captured, one each at Stations 23, 28 and 29. Marginal habitat conditions probably restrict this species in the study area, although brown trout are reportedly more tolerant than other trouts to silt and high temperatures (Beckman, 1952).

Rainbow trout, Salmo gairdneri (introduced) - Five rainbow trout were captured, one in October and four in April at Stations 29 and 28, respectively. As with the other trout species, the small number of fish is due to marginal environmental conditions.

Of the nine trout of all species captured to date, eight were taken at or just below the mouth of Yellow Creek at Stations 28 and 29. The most plausible reason for this is the existence of more cover, i.e., undercut banks, brush piles, in this side-channel area compared to the main river (Stations 27, 28, and 29 are separated from the main river by an island).

As mentioned under the discussion of cutthroat trout, high summer water temperatures are considered one of the "marginal" habitat conditions for trout. However, this is not a clear-cut phenomenon. White River temperatures during summer 1975 (RBOSP 1976) and summer 1973 (Pennak, 1974) ranged from 15-21°C and 8.5-15.3°C, respectively. These temperatures are within the preferred range of rainbow and brown trout (McAfee, 1966; Scott and Crossman, 1973). However, Everhart and May (1973) reported a maximum temperature of 24°C for the White River in July 1969. This was in excess of the upper preferred temperature of rainbow trout and at the upper preferred limit of brown trout. It may be that the occasional high water temperatures, along with the silt load and competition from warm-water species, are enough to restrict trout populations in the study areas.

Mountain whitefish, Prosopium williamsoni (native) - Seventeen mountain whitefish were captured at various stations during October 1974 and April and September 1975. Most of these specimens were sexually immature age class I fish (see age-growth section). Little information can be derived about the mountain whitefish population because of the small catch. The small catch of this species may be due to the species preference for deep, fast runs, a habitat type which proved difficult to sample during the RBOSP studies. Goodnight and Bjornn (1971) cited this as the reason for their limited success in collecting mountain whitefish in the Lemhi River, Idaho.

3) Family Cyprinidae - Roundtail chub, Gila robusta (native) - Specimens of roundtail chub were captured during every sampling except that, in October - November 1974, relatively few fish were captured. The largest catch was 10 specimens in June 1975.

The roundtail chub is the "dominant native carnivore" of Colorado River tributary streams according to Holden and Stalnaker (1975b). These authors indicated the species was abundant in the White River, but gave no specific data. The species is widely distributed in the Colorado River Basin (Holden and Stalnaker, 1970) and is holding its own against introduced species, at least in Arizona (Minckley, 1973).

Speckled dace, Rhinichthys osculus (native) - This species was the most abundant species captured during the initial year of study. It was numerous in White River near Piceance and Yellow creeks (Pettus, undated) and in the Middle and Upper Colorado River Basins (Holden and Stalnaker, 1975b).

Since RBOSP Progress Reports 2, 3, and 4, additional taxonomic study has shown that specimens previously identified as longnose dace, Rhinichthys cataractae, are instead, speckled dace, Rhinichthys osculus.

Fathead minnow, Pimephales promelas (introduced) - This species is not native west of the Rocky Mountains (Miller, 1952), but its popularity as a baitfish has apparently resulted in its introduction in many parts of the western U.S. The species was first reported from the Middle and Upper Colorado River

Basins in the late 1950's and early 1960's and was reported common (but never abundant) throughout the area in 1967-1973 (Holden and Stalnaker, 1975b). Andrews (1971) reported the species widely introduced in western Colorado.

Over 300 specimens were captured during RBOSP Aquatic Studies, making it the fourth most abundant fish in the catch. In their 1969 sampling of Piceance Creek, the White River and Yellow Creek, Everhart and May (1973) recorded no fathead minnows. Four years later, Pettus (undated) reported four specimens, three in Piceance Creek and one in the White River. Notwithstanding the greater intensity of the RBOSP Baseline Study, the numbers of fathead minnows captured indicate a recent increase in the population in the study area.

Red shiner, Notropis lutrensis (introduced) - Only 11 red shiners were captured, one in July and 10 in September, all near the mouth of Yellow Creek at Stations 27, 28, and 29.

The red shiner was reported from the White River near the present study area in 1969 by Everhart and May (1973), but was not reported by Pettus (undated) from a 1973 sampling. Holden and Stalnaker (1975b) reported that the red shiner was a recent introduction in the Upper Colorado River Basin and that it was extending its range up the Green River (Utah) during the period 1967-1973. They reported capturing one specimen in the White River.

Carp, Cyprinus carpio (introduced) - Twenty-seven specimens were captured during the study period, most of these were small (less than 100 mm (3.9 in.)) and were captured in September 1975.

Holden and Stalnaker (1975b) reported that carp was widely distributed in the Middle and Upper Colorado River Basins but it was generally not abundant. Neither Everhart and May (1973) nor Pettus (undated) reported the carp from the White River.

4) Family Catostomidae - Flannelmouth sucker, Catostomus latipinnis (native) - The flannelmouth sucker was the most abundant "large" fish captured during the period. Over 500 were captured, with numerous specimens being taken during each sampling period (Table 3-8-21). They were captured in every type of habitat, from swift, relatively deep runs to shallow runs over rocky substrate to mud-bottom pools. Greater numbers were captured in the latter habitat, probably due to greater sampling efficiency in these areas.

The flannelmouth sucker is one of the most widespread and abundant large fishes in the Colorado, San Juan, and Green Rivers (McDonald and Dotson, 1960), Green River (Miller, 1964), Yampa and Dolores Rivers (Holden and Stalnaker, 1975a) and the Middle and Upper Colorado River Basins in general (Holden and Stalnaker, 1975b). The species was reported common in the White River near the present study area (Pettus, undated). Everhart and May (1973) recorded the species but gave no abundance data. Although the flannelmouth sucker is still a relatively widespread species in the Colorado River Basin, both Behnke (undated) and Minckley (1973) reported the species reduced in range, particularly in the lower basin. Minckley indicated that it is a "large-river" species and consequently has been reduced in the lower basin due to impoundments.

Bluehead sucker, Catostomus discobolus (native) - Smith (1966) reported this species widespread in the Colorado River System above the Grand Canyon. It also occurs in the Snake River drainage (Columbia River System) in Idaho and Wyoming, and in Bonneville Basin streams in Idaho, Wyoming, and Utah. Beckman (1952) and Holden and Stalnaker (1975b) reported that the species prefers gravel-bottom streams.

During the present RBOSP Baseline Studies, 159 bluehead suckers were captured. This indicates the species is common but not abundant. Smith (1966) did not list a single White River record (in Colorado) for the bluehead sucker on his species distribution map. However, rather than reflecting actual distribution, it probably resulted from the dearth of research on the White

River in Colorado. Most previous sampling and research emphasis has been on the mainstream Colorado River and other tributary streams. Everhart and May (1973) did not report the species from the White River. However, Pettus (undated) found it the most abundant large species in his catch in 1973.

Mountain sucker, Catostomus platyrhynchus (native) - Only two specimens of mountain sucker were encountered during the study period, one in July and one in September 1975.

The mountain sucker is widely distributed in the western U.S. and Canada, occurring in various drainages from California to British Columbia and east to Saskatchewan and South Dakota, and south to Utah (Smith, 1966). However, Smith gave only one record of the species in Colorado, in Piceance Creek, and indicated that it was the most isolated population of the species in the Colorado River Basin. Behnke (personal communication) indicated that no additional locality records for Colorado have been reported since Smith's (1966) report. Everhart and May (1973) reported the species in both Piceance Creek and the White River. Pettus (undated) encountered the species only in Piceance Creek.

The mountain sucker is usually an inhabitant of small mountain streams (Smith, 1966). Consequently, it has not appeared in data from studies of the Colorado River mainstream and major tributaries (e.g., Holden and Stalnaker, 1975b). The occurrence of the species in the White River near the RBOSP study area probably represents a few strays from the Piceance Creek population rather than an actual White River population.

5) Family Ictaluridae - Channel catfish, Ictalurus punctatus (introduced) - One adult channel catfish was caught during September 1975 at Station 27.

Since this species was introduced into the Colorado River system in the late 1800's, it apparently became widely established by the early 1900's (Holden and Stalnaker, 1975b). Channel catfish was the most abundant species encountered in the Colorado and San Juan rivers in the Glen Canyon area

(McDonald and Dotson, 1960). The species was not recorded from the White River near the RBOSP tract by Pettus (undated), but was recorded by Everhart and May (1973).

Channel catfish may be more abundant in the White River study area than the data indicate. A local resident indicated that channel catfish can be readily taken by hook and line during the summer. May (personal communication) reported two local fishermen caught about 12 channel catfish several miles upstream of the RBOSP tract during one day in summer 1969. Holden and Stalnaker (1975b) indicated that "adults (channel catfish) were seldom taken with conventional collecting gear but were readily caught on hook and line."

Black bullhead, Ictalurus melas (introduced) - One black bullhead was captured in July 1975 at Station 26. The species was also reported from the general RBOSP study area by Everhart and May (1973). The species was reported in low numbers from several of locations in the Glen Canyon area of the Colorado River (McDonald and Dotson, 1960), the Flaming Gorge area of the Green River (Vanicek et al., 1970) and the Green and Yampa rivers (Holden and Stalnaker, 1975b). The latter authors found the species common only in the slow-flowing waters of the lower Green River.

6.) Family Cottidae - Mottled sculpin, Cottus bairdi (native) - The mottled sculpin was quite abundant in the study area and was taken during every sampling period. The great differences in abundance between sampling periods (Table 3-8-21) reflects variability of stream conditions and sampling efficiency rather than actual abundance.

This species appears infrequently or not at all in the records of studies done on the mainstream Colorado River and larger tributaries (Holden and Stalnaker, 1975a and b, Vanicek et al., 1970, McDonald and Dotson, 1960). Mottled sculpin prefer cool to cold mountain streams (Beckman, 1952; Miller, 1964). The abundance of mottled sculpin in the study area points to the "cold water" characteristics of the stream. (The mixture of cold and warm-water species encountered in the study area may justify the classification

of the White River in the study area as "intermediate" between cold and warmwater habitat.)

7) Hybrids - Only one hybrid form has been captured to date, the flannelmouth sucker X bluehead sucker hybrid (Catostomus latipinnis X Catostomus discobolus). Three specimens were captured, one in April 1975 and two in September 1975. This hybrid cross was first described by Hubbs et al. (1943) from the Virgin River System, Utah, and subsequently by Hubbs and Hubbs (1947) from the Gunnison and San Juan river systems in Colorado.

Vanicek et al. (1970) and Holden and Stalnaker (1975b) reported catostomid hybrids, but did not record the flannelmouth sucker X bluehead sucker hybrid, despite both species occurring together in abundance. Hubbs and Hubbs (1947) stated that these two species probably have a naturally low frequency of hybridization compared to some other sucker species.

8) Other species - The white sucker, reported from the White River by Pettus (undated), is of interest because it may be "moving into" the area. Only one specimen was captured in the river while 31 were captured in Piceance Creek by Pettus. The species was first introduced into the Colorado River in about 1926 (Hubbs et al., 1943), and has spread rapidly. Holden and Stalnaker (1975b) found the white sucker to be abundant in the upper Yampa River and rare in the lower Yampa, upper Green and Colorado rivers. The species is yet to be encountered in the present RBOSP baseline study.

b. Relative Abundance and Distribution - To gain some insight into the relative abundance and distribution of fishes from the RBOSP studies, analyses of mean numbers, mean weight, and mean number of species captured to date were made for each station (Figures 3-8-26, 3-8-27, and 3-8-28). Relative abundance and distribution are discussed below by "geographical" areas, i.e., White River above Yellow Creek, confluence of Yellow Creek with White River, and White River below Yellow Creek. The grouping is not based on habitat, as various habitats, e.g., riffle, pool, exist in each area. However, the grouping is pertinent to the baseline and monitoring

3-8-652

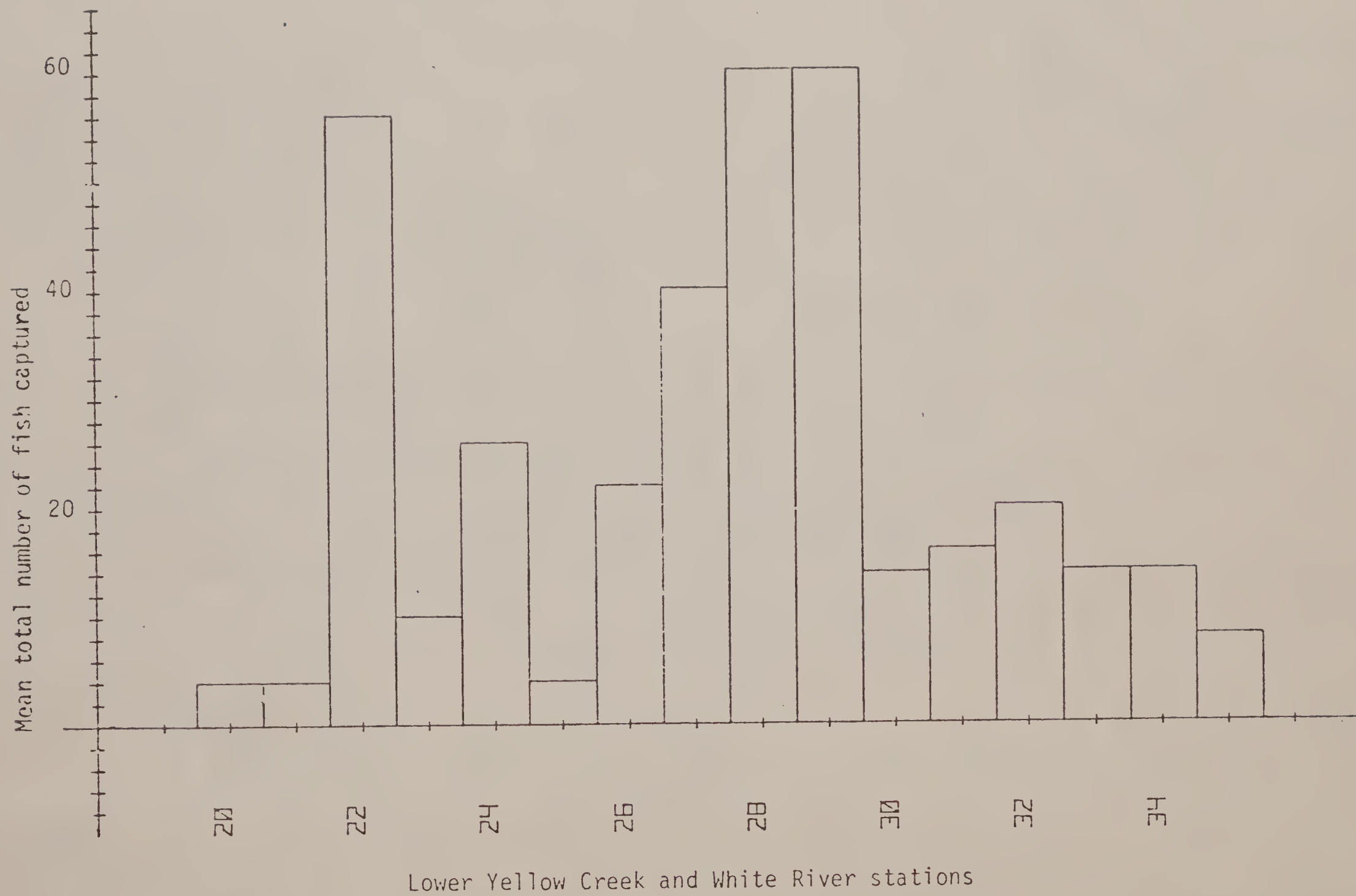


Figure 3-8-26. Mean total number of fish captured for five sampling periods, October 1974 - September 1975.

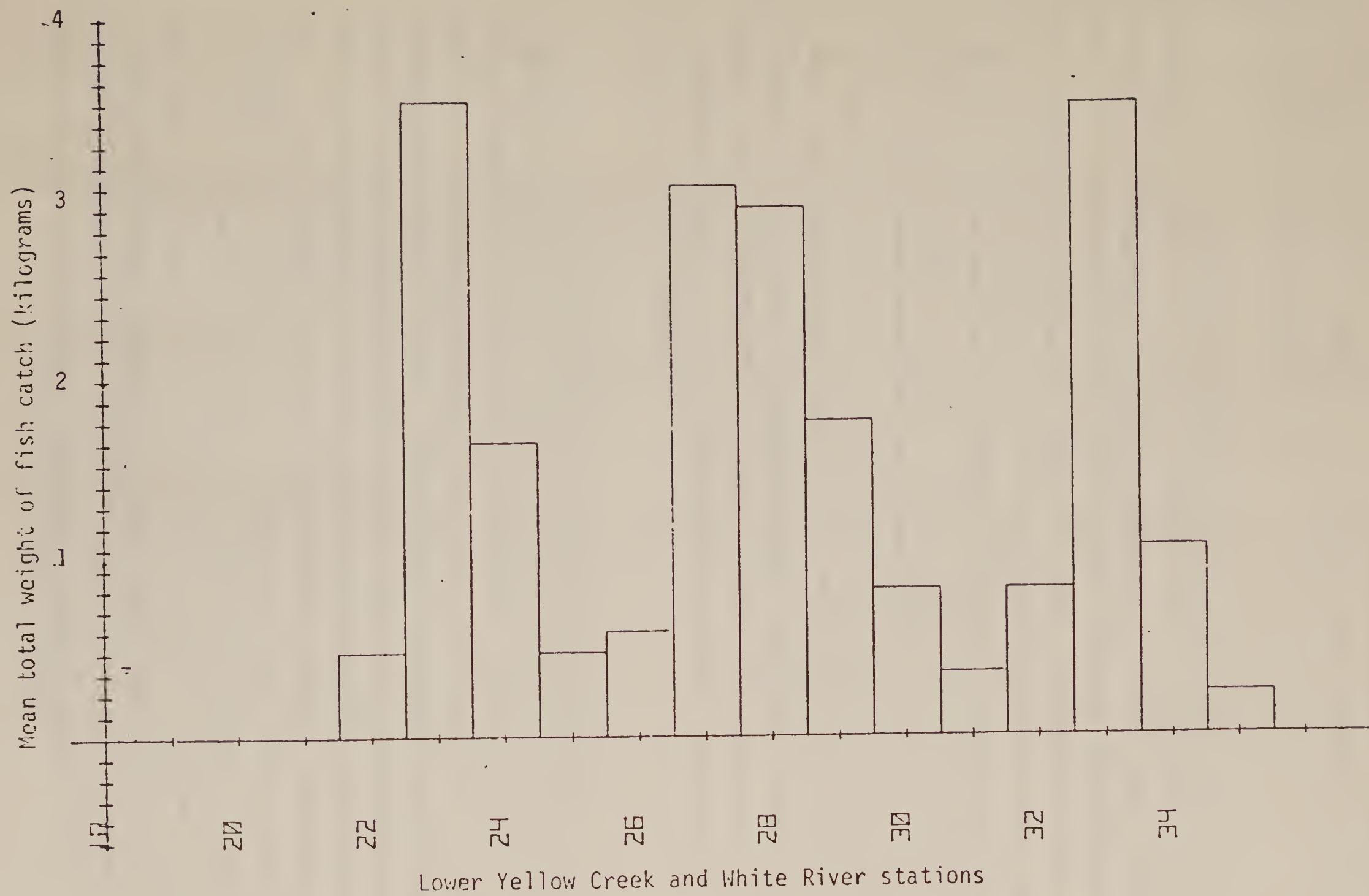


Figure 3-8-27. Mean total catch weights for five sampling periods, October 1974 - September 1975.

3-8-654

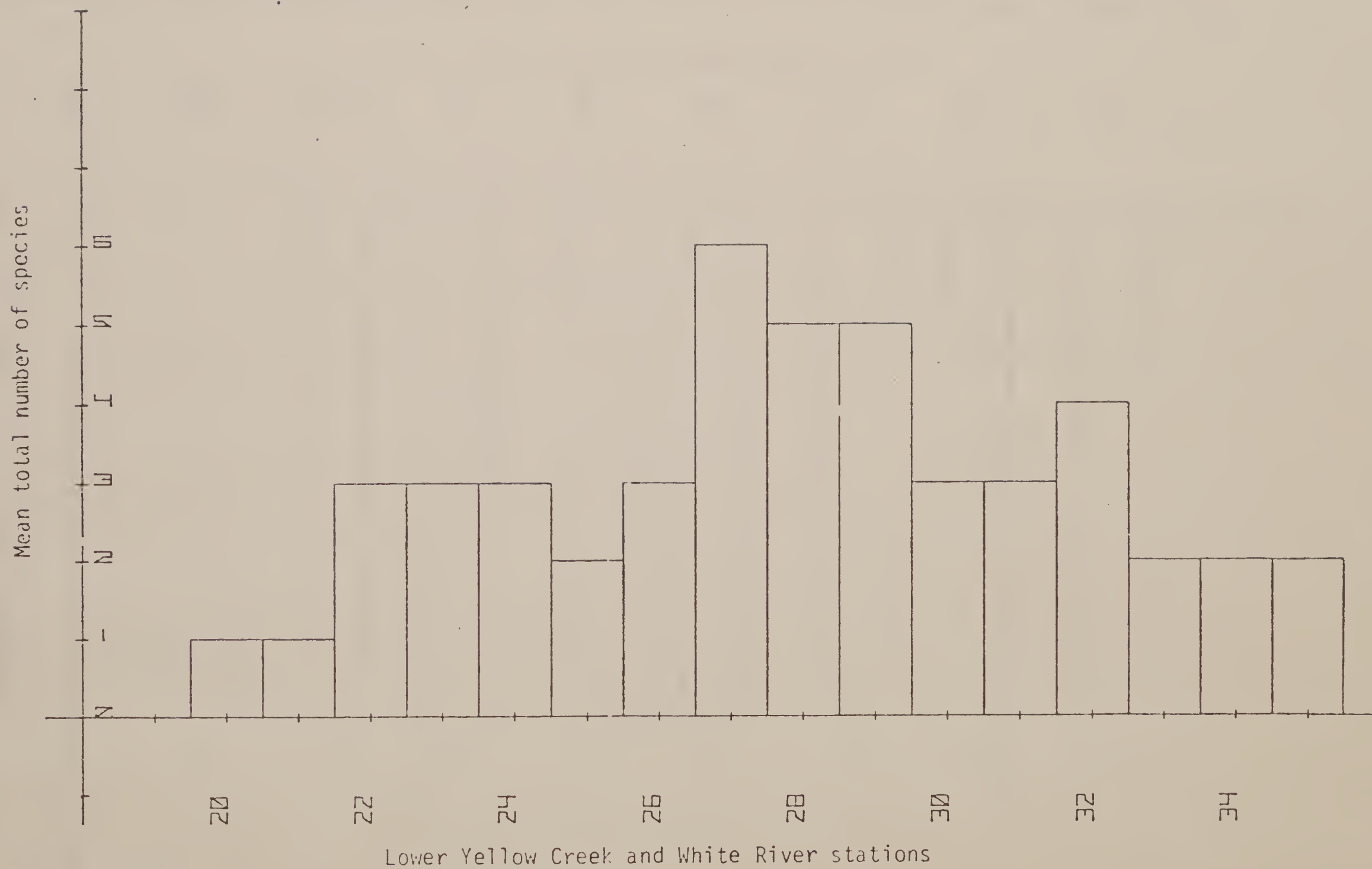


Figure 3-8-28. Mean total number of fish species captured for five sampling periods, October 1974 - September 1975.

aspects of the program because each area has the potential of being affected differently by any environmental perturbation, with the White River above Yellow Creek being the control area.

1) Yellow Creek (Stations 19-22) - The catch at Yellow Creek Stations 20, 21 and 22 was low in numbers, weight, and species. This reflects the small amount of habitat available in Yellow Creek. Yellow Creek is a stream which becomes essentially a series of isolated warm water pools during much of the year. Station 22, near the mouth of Yellow Creek, is clearly different in all respects from the other Yellow Creek stations. At that station, a substantial increase in weight and species, and especially numbers is evident. What is not shown on the polygons, however, is that the major difference between Station 22 and the other stations is the result of one sampling in June 1975. The sampling occurred during spring runoff and water was backed up into Yellow Creek through the length of Station 22. The catch included roundtail chub, speckled dace, fathead minnow, carp, flannelmouth and bluehead suckers. The spring runoff periods is apparently the only time Yellow Creek is used by fishes and the catch at other times was very low.

2) White River above Yellow Creek (Stations 23-27) - This section produced a variety of catch results, primarily because of the variable habitat encountered and sampling efficiencies. Compared to other stations, Station 23 was roughly median in numbers and species captured, but had the highest mean weight of catch. This reflects a preponderance of larger fishes (mostly suckers) captured at this station, due to the pool-type habitat and the increased sampling efficiency gained by blocking off this section with nets. Stations 24-26 represent a main-channel transect. Although not affected by back channels or block netting, the catch from this area still shows the influence of both habitat and sampling efficiency. Station 24 contains both shallow riffle and pool habitat and this is probably the cause of the greater numbers and weight captured relative to Stations 25 and 26. Station 27 produced greater catches in numbers, weight, and species than the other stations in this group. The obvious reason is that it is in a back-

channel, mostly pool habitat, and is usually effectively blocked off during sampling.

3) Yellow Creek confluence with White River (Stations 28 and 29 -
This area produced the greatest catch of the study area in terms of numbers, number of species, and mean weight of fish. These results are apparently due to a variety of habitats available in this back channel, e.g., deep riffle, shallow riffle, pool, undercut banks, and the greater sampling efficiency due to blocking nets.

4) White River below Yellow Creek - The catches from this area were unremarkable in both numbers and species. However, Station 33, the only back channel, primarily pool station in the group, produced one of the highest catch weights of all stations, composed mostly of relatively large suckers.

The obvious influence of habitat type and sampling efficiency on sampling results requires discussion of the results from a different perspective than station grouping. Stations 23, 27, 28, 29, and 30 are all similar in that they are located in back channels, can be blocked off during most sampling periods, and contain all or partial pool habitat. Considering these stations as a unit, the agreement in weight (Figure 3-8-27) is very close. Station 29 is somewhat lower than the others, but has more riffle habitat, thus precluding the occurrence of great numbers of larger fish. On the other hand, the open-water stations (impossible to block off), which consist mostly of riffle habitat (Stations 24, 25, 26, 30, 31, 32, 34 and 35) were generally much lower in numbers and weight of fishes captured. How much of this difference is "real" and how much is a function of unavoidably different sampling intensities is impossible to determine.

c. Age and Growth

1) Flannemouth sucker - Data for length-frequency and scale analysis are given for the flannemouth sucker (Figure 3-8-29 and 3-8-30 and Table 3-8-228). However, the data must be interpreted with caution

because: 1) insufficient samples were collected for some age classes; 2) scales proved very difficult to read, particularly from older age groups; and 3) no previous study has validated the scale method for the flannelmouth sucker. Because of these problems, only data on smaller fish (<314 mm) are presented, which presumably affords greater scale-reading accuracy.

One age class appears on the June length-frequency polygon (Figure 3-8-29). The peak represents Age Class I fish, fish that had grown to an average 55 to 59 mm in approximately one year of life. From scale readings data (Table 3-8-228), the length range and particularly, the modal length for Age Class I are very similar to the length-frequency derived range and mode. This is of little value in corroborating annuli (year marks) on scales because most Age Class I fish in June had not yet formed an annulus on their scales.

The two peaks on the September length-frequency polygon (Figure 3-8-30) represent Age Class 0 (left) and Age Class I. The Age Class 0 fish grew to a modal length of 44-47 mm (1.8 in.) since hatching earlier in the year. The Age Class I peak is somewhat spread out but appears corroborated as an age class mode by the similar length mode and range for September Age Class I fish aged by scale analyses. The agreement between length-frequency and scale data for Age Class I gives some support for the use of flannelmouth sucker scales; each scale in the Age Class I group had one annulus. Most of the scales from this same age class in June had no annuli.

The difference in modal lengths between Age Class I fish in June and September (Table 3-8-228) indicates additional average growth of 37 mm (1.5 in.) during the three month period. It thus appears, at least from the present sample, that flannelmouth suckers grow to around 100 mm (3.9 in.) by the end of their second growing season.

Only one published reference, McDonald and Dotson, (1960), to age and growth of the flannelmouth sucker has been found. These authors reported ages of 12 specimens from the Glen Canyon area of the Colorado River. The specimens ranged in age from one to six years old for a 105 to 363 mm (4.1 to 14.3 in.)

Table 3-8-228. Results of flannelmouth sucker age analyses by scale reading.

	<u>Number of specimens</u>	<u>modal length</u>	<u>mean length</u>	<u>length range</u>
<u>June 1975</u>				
Age Class I	25	55 mm	59 mm	49-124 mm
Age Class II	25	69	109	63-206
Age Class III	3	-	196	162-242
Age Class IV	2	-	233	226-239
<u>July 1975</u>				
Age Class II	4	-	186	125-225
Age Class III	13	-	263	198-314
Age Class IV	1	-	-	308
<u>Sept. 1975</u>				
Age Class I	23	92	101	86-131
Age Class II	4	-	165	138-187
Age Class III	8	-	264	170-312

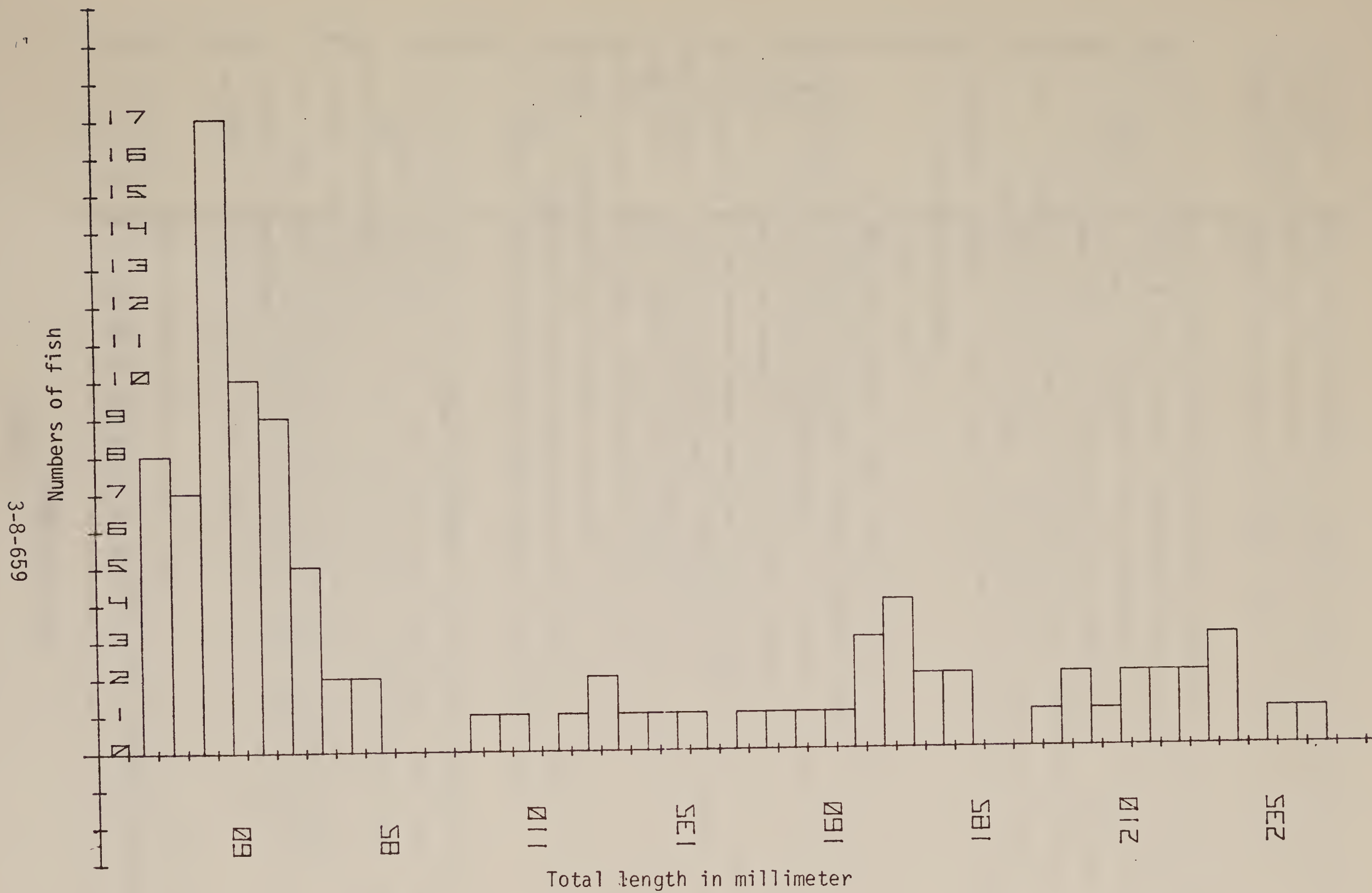


Figure 3-8-29. Length - frequency distribution of 98 flannelmouth suckers, June 1975.

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3-3-660

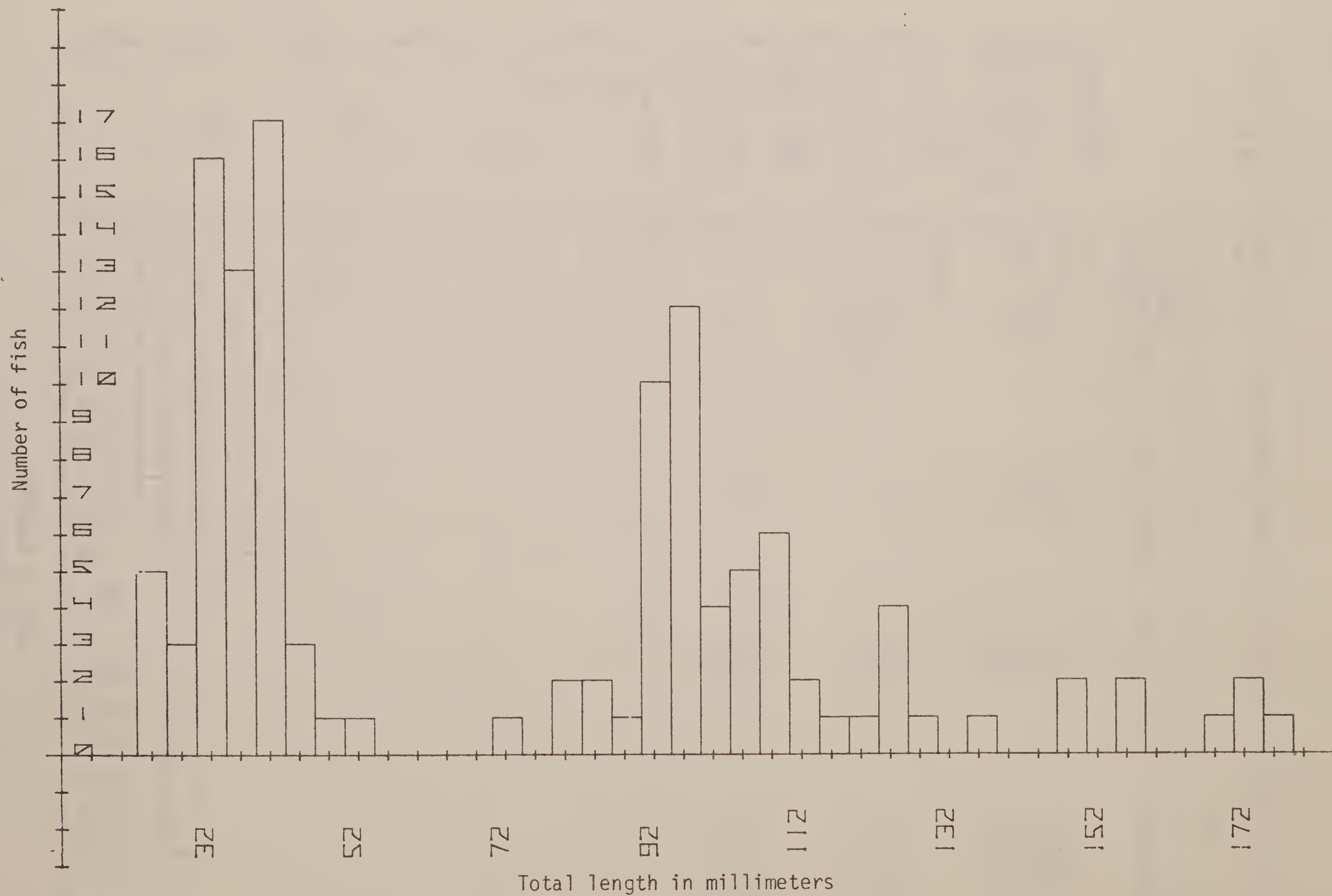


Figure 3-8-30. Length - frequency distribution of 120 flannelmouth suckers, September 1975.

size range. Either the scale method or opercle bone method (annuli appear on all hard parts of fish) was used in the study of McDonald and Dotson (1960). No information was given on criteria used to identify annuli.

A study is presently being carried out at Utah State University by Dr. Richard Wydoski on the life history of the flannelmouth sucker (Wydoski, personal communication). These investigators have encountered the same problems in aging flannelmouth sucker as encountered in the RBOSP study. They have several investigations underway to establish whether flannelmouth sucker scales are valid indicators of age. The information derived from these studies may be useful in resolving the problems of studying age and growth of the flannelmouth sucker.

2) Mottled sculpin - Some insight into age structure and growth rates of mottled sculpin was gained through length-frequency analysis of October-November 1974 and August-September 1975 samples (Figures 3-8-31 and 3-8-32). Two peaks are shown in each frequency polygon, the first (leftmost) representing a single age class, and the second a combination of several age classes. In the October-November 1974 sample, the first peak represents Age Class I fish. Because of the late season sampling, these fish were nearing the end of their second growing season when captured. The second peak, smaller and less distinct, represents fish of Age Class II and older. The small number of specimens and greater overlapping of lengths of older age classes prohibits separating age classes in the second peak.

The two peaks shown in the August-September 1975 polygon represent Age Class 0 (leftmost) and older fish. The mode of the second peak (76-77 mm, 13.0 in.) may represent Age Class I fish, although this is considerably larger than the modal length of Age Class I fish in the October 1974 sample. Age Class 0 fish were poorly represented in the catches; only 15 specimens were captured in September 1975 and none in October 1974. This is due to reduced sampling efficiency with this age class.

The growth rates of early age classes of mottled sculpin at the RBOSP site are similar to those determined by West Gallatin River, Montana specimens

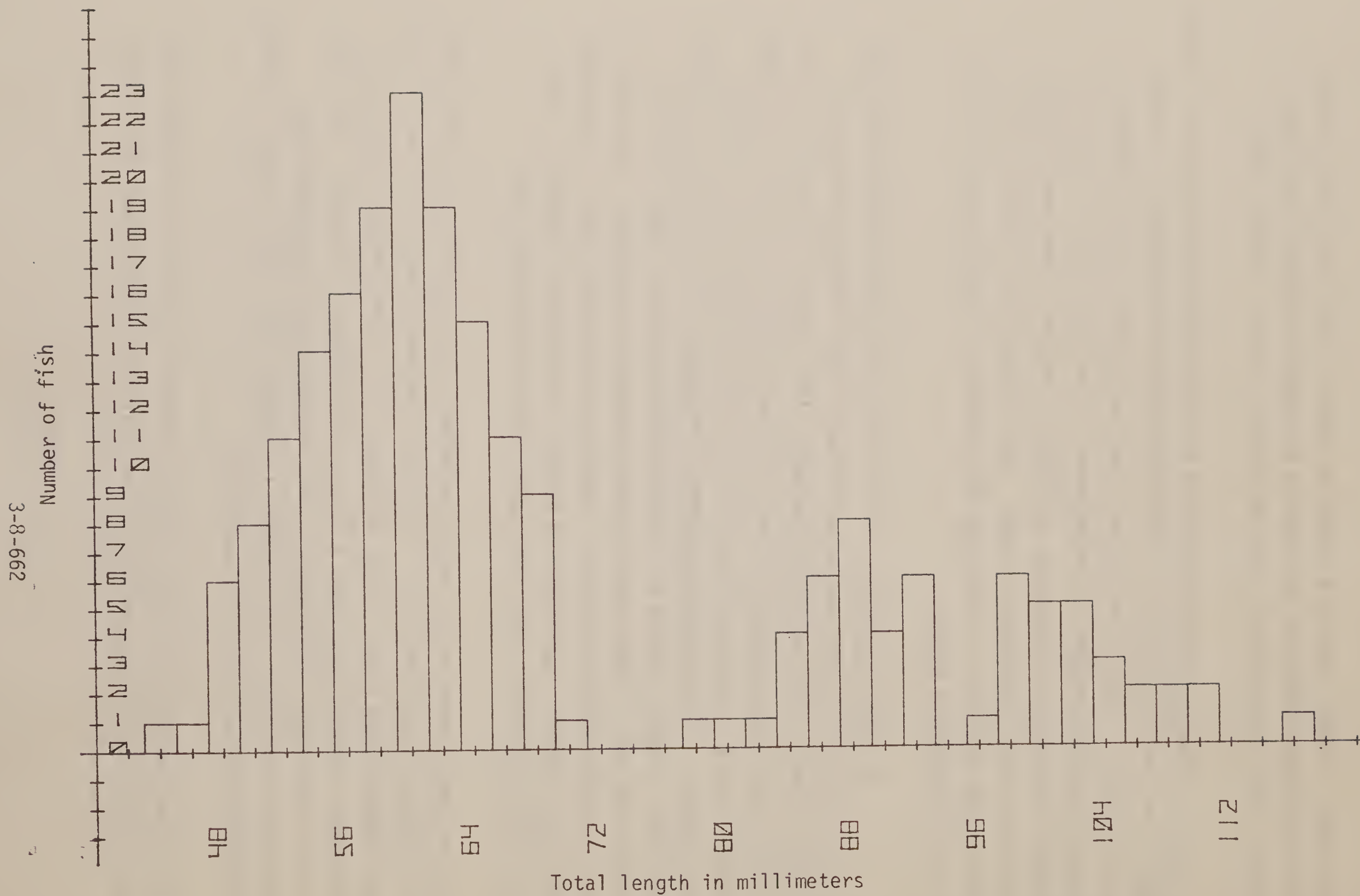


Figure 3-8-31. Length - frequency distribution of 212 mottled sculpin, October 1974.

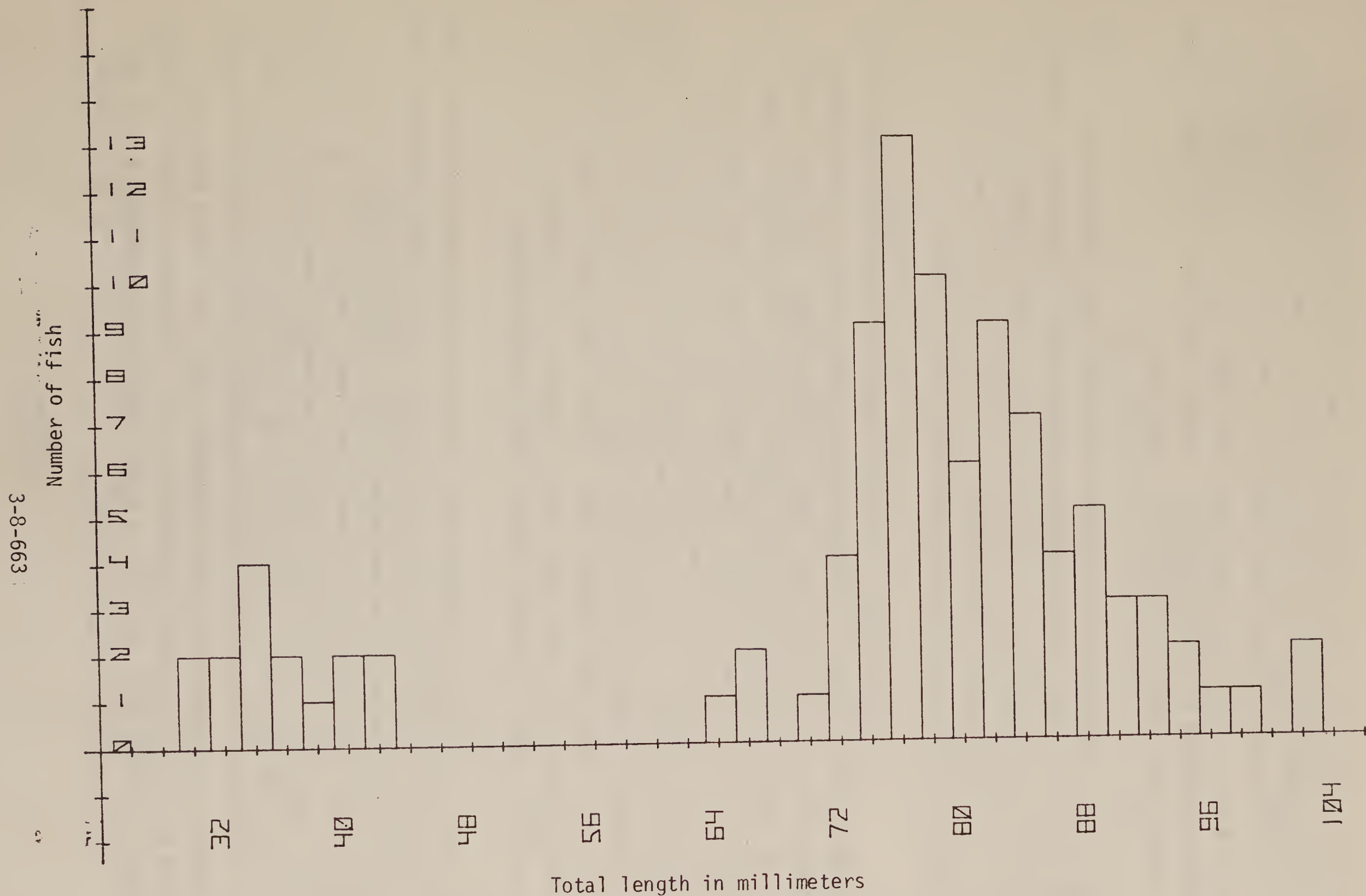


Figure 3-8-32. Length-frequency distribution of 98 mottled sculpin, September 1975.

(Bailey, 1952). The modal length of Age Class I fish taken in the West Gallatin River in October was 61.5 mm (2.4 in.). The corresponding mode for fish captured during October-November in the present study was 60 to 61 mm (2.4 in.). The data on Age Class II and older fish are inconclusive in both the Montana and present studies. Too few Age Class 0 fish were captured in the present study to provide useful analysis.

The largest mottled sculpin captured in the RBOSP study area to date was 116 mm (4.6 in.). Bailey (1952) reported a 140 mm (5.5 in.) specimen from the West Gallatin River system. Scott and Crossman (1973) reported a 132 mm (5.2 in.) specimen from Lake Superior. A 142 mm (5.6 in.) specimen was captured in the Green River by McDonald and Dotson (1960).

3) Speckled dace - A length-frequency analysis was conducted on speckled dace captured in September 1975 (Figure 3-8-33). At least two, and possibly three, age classes appear on the polygon. Age Class 0 fish, which spawned earlier in the year, appear at the left side with a modal length of 36 to 37 mm (1.4 in.). The middle peak represents Age Class I fish with a mode of 66 to 67 mm (2.6 in.). The right side peak, modal length 86 to 87 mm (3.4 in.) may represent Age Class II fish; however, there is considerable overlap with the Age Class I peak. Although one other study (Jhringran, 1948 in Carlander, 1969) indicated that speckled dace live to at least Age Class III, such older fish, if present in the White River, were too few in number to create a peak on the frequency polygon.

A comparison of length-frequency data for White River speckled dace was made with data from the Trinity River, California, speckled dace (Jhringran, 1948). Dace from the Trinity River exhibited a modal length of 31 mm (1.2 in.); White River specimens (Figure 3-8-33) had a modal length of 36 to 37 mm (1.4 in.). Age Class I dace in the Trinity River ranged from 36 to 45 mm (1.4 to 1.8 in.) and Age Class II from 49 to 58 mm (1.9 to 2.3 in.). These values are considerably smaller than the corresponding values for White River dace. However, Carlander (1969) gives no capture dates for Trinity River fish past Age Class 0, making comparison difficult. Whatever the sampling dates, since the White River Age Class I modal length (66 to 67 mm (2.6 in.) well

3-8-665

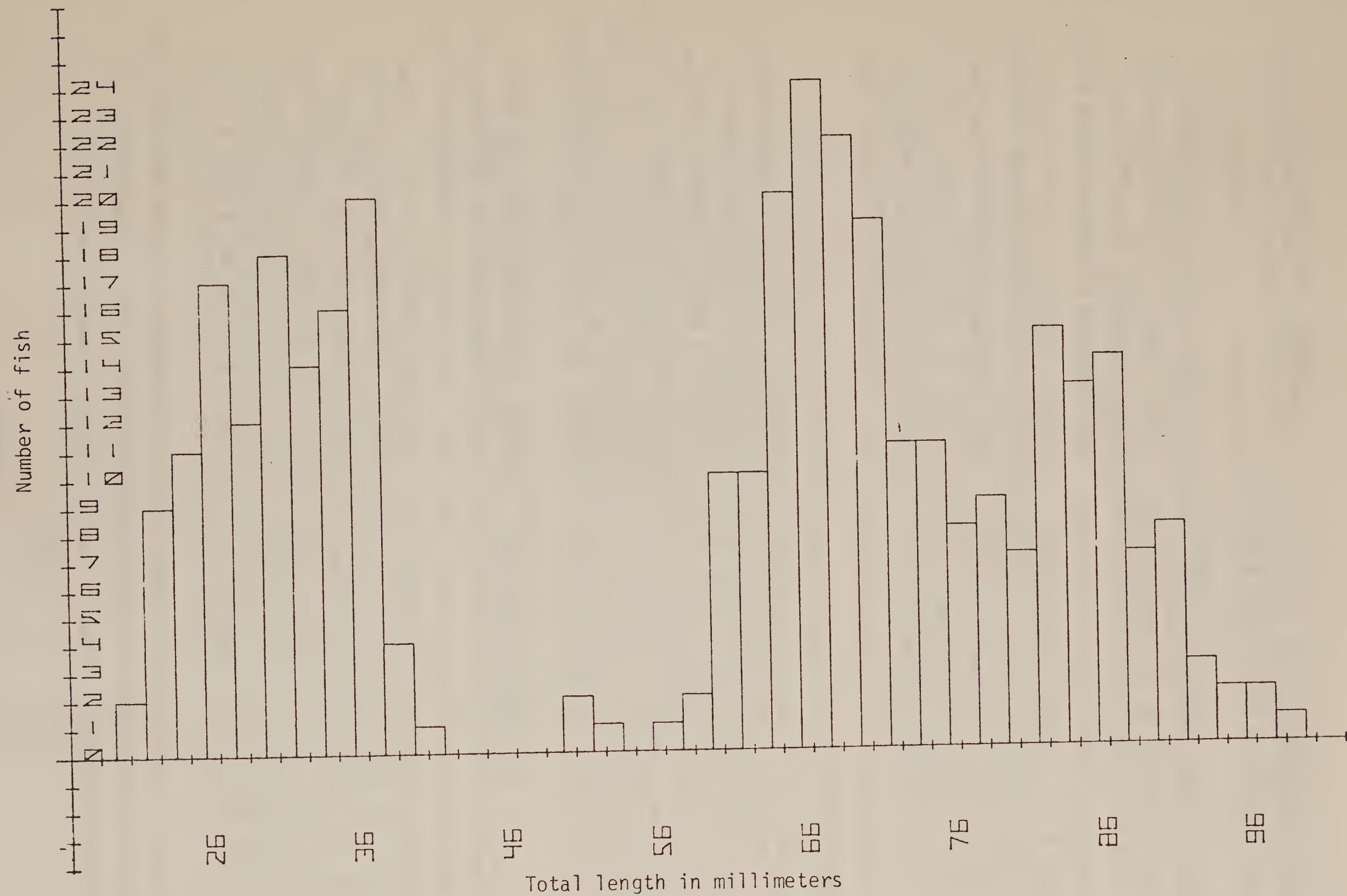


Figure 3-8-33. Length - frequency distribution of 346 speckled dace, September 1975.

exceeds the length range of Trinity River Age Class II fish, the White River population has a much better growth rate.

There is some confusion in the literature concerning the maximum total length attained by the speckled dace. Miller (1964), Scott and Crossman (1973) and Koster (1957) reported the maximum length as 76 mm (3.0 in.). Jhringran (1948) (cited in Carlander, 1969) reported a maximum length of 88 mm (3.5 in.) in the Trinity River, California. However, speckled dace of at least 100 mm (3.9 in.) have been observed in Colorado by Behnke (personal communication). McDonald and Dotson (1960) reported a number of specimens from the Flaming Gorge area of the Green River in excess of 100 mm (3.9 in.) and one measuring 121 mm (4.8 in.) In the present RBOSP study, numerous specimens over 90 mm and seven over 100 mm, including one at 109 mm, have been captured.

The reason for the discrepancy in reported maximum lengths of speckled dace is most probably linked to the wide morphological variability reported for this species. Minckley (1973), citing Miller and Miller (1948), indicated that it was one of the most variable species in western North America. Scott and Crossman (1973) stated that variability was so great that it seems likely that more than one species may be involved in the taxon, Rhinichthys osculus.

4) Mountain whitefish - Although few mountain whitefish were captured, scale analysis results are reported here because of the potential importance of this species as a sport fish. The results of analysis of six specimens captured in September are: mean length 121 mm (4.8 in.), range 118 to 124 mm (4.6 to 4.9 in.), Age Class 0. These fish were larger than same age fish reported by Brown (1952) for the Gallatin River, Montana (95 mm, 3.7 in.), or one year old fish reported by Sigler and Miller (1963) for the Logan River, Utah (117 mm, 4.6 in.) and Pettit and Wallace (1975) for the North Fork Clearwater River, Idaho (113 to 115 mm, 4.4 to 4.5 in.).

The small sample size precludes confident estimates of growth rates for the mountain whitefish population in the White River. This may be possible if subsequent sampling produces greater numbers of mountain whitefish.

d. Condition Factors - Condition factors (K) have been frequently used to describe the "plumpness" or "well-being" of fish (Carlander, 1969). Its principle value lies in comparing calculated conditions factors with published values for the same species in other waters, i.e., comparing the present population with the "average" for the species to determine relative "well-being" and establishing a baseline with which to detect possible further environmental perturbation.

Condition factors for five relatively abundant fish species at the RBOSP site are presented in Table 3-8-229. The data are broken down by date, size range, and, in the case of the flannelmouth sucker, sex. However, due to the disparity of sample sizes among the various groupings, emphasis will be placed on the combined data.

The mean K value for all flannelmouth suckers taken to date in the RBOSP studies is 0.87. This is essentially the same as the value 0.84 calculated from the data of Dotson (1960) and McDonald and Dotson (1960) for flannelmouth suckers from the Flaming Gorge area of the Green River. No significant changes in K values were observed with increasing size of the Green River flannelmouth suckers. The same appears true of the RBOSP flannelmouth from observation of Table 3-8-229. McDonald and Dotson (1960) suggested that the homogeneity of K values for flannelmouth resulted from low intra-specific competition due to a herbivorous feeding habit; data from the present RBOSP studies suggest that this may not be the case (see section 8.F.4d, food habits).

Little information concerning condition factors exists in the literature for the other species. K values were calculated from a small amount of length-weight data on speckled dace from Jhringran (1948) (cited in Carlander, 1969). The mean calculated K value, 0.56, is almost 50% lower than the 1.04 value calculated for the RBOSP speckled dace; however, the great inter-population variability of the speckled dace could be responsible for much of this difference.

Table 3-8-229. Condition (K) factors for five fish species captured at the RBOSP site from October 1974 through September 1975.

Length Range (mm)	October 1974				April 1975				June 1975				July 1975				September 1975				All Sampling Periods	
	Min.	Max.	$\bar{x}$	N	Min.	Max.	$\bar{x}$	N	Min.	Max.	$\bar{x}$	N	Min.	Max.	$\bar{x}$	N	Min.	Max.	$\bar{x}$	N	$\bar{x}$	N
<u>Flannelmouth sucker</u>																						
0-60	0.62	1.29	0.93	30	0.77	0.82	0.82	2	0.60	1.42	0.97	41	0.87	0.87	0.87	1	0.41	1.14	0.76	59	0.86	133
61-120	0.60	0.90	0.85	2	0.93	1.03	0.98	2	0.76	1.19	0.96	34	0.83	1.17	0.94	8	0.81	1.07	0.90	43	0.92	89
121-240	--	--	--	--	0.61	1.11	0.82	10	0.60	1.03	0.89	33	0.47	1.21	0.81	26	0.80	1.02	0.92	24	0.87	93
240-320	--	--	--	--	0.71	0.95	0.80	18	0.76	0.85	0.81	3	0.69	1.02	0.82	31	0.76	0.90	0.83	9	0.82	61
>320	0.73	0.93	0.82	10	0.75	1.05	0.89	34	0.76	1.11	0.88	16	0.72	1.13	0.89	43	0.74	0.89	0.81	24	0.87	129
All groups			0.90	42			0.85	66			0.93	129			0.86	109			0.83	159	0.87	505
Male	0.90	0.90	0.90	1	0.80	0.95	0.89	8	0.83	1.11	0.93	5	0.75	1.13	0.89	26	0.77	0.87	0.81	7	0.88	47
Female	0.73	0.73	0.73	1	0.84	1.05	0.94	11	0.76	0.99	0.84	8	0.72	1.09	0.88	23	0.77	0.89	0.83	8	0.87	51
All groups			0.81	2			0.92	19			0.87	13			0.89	49			0.82	15	0.88	98
<u>Fathead minnow</u>																						
All groups	0.92	1.36	1.09	88	0.67	1.22	1.06	10	1.27	1.56	1.40	5	0.93	1.39	1.16	2	0.82	1.36	1.14	16	1.11	121
<u>Bluehead sucker</u>																						
0-200	0.46	1.40	0.96	26	0.77	0.95	0.85	14	0.49	1.10	0.89	4	0.53	1.56	0.95	16	0.57	1.16	0.94	61	0.94	121
>201	--	--	--	--	0.85	1.10	0.94	10	0.68	0.92	0.78	5	0.80	0.80	0.80	1	--	--	--	--	0.88	16
All groups			0.96	26			0.91	14			0.86	19			0.94	17				61	0.93	137
<u>Mottled sculpin</u>																						
0-50	1.32	1.70	1.51	9	--	--	--	--	--	--	--	--	--	--	--	--	1.07	1.35	1.20	15	1.31	24
51-75	0.94	1.78	1.45	87	1.36	1.93	1.61	22	1.46	1.46	1.46	1	1.21	1.43	1.33	5	0.99	1.52	1.32	19	1.45	134
>76	0.47	1.76	1.47	27	1.51	2.00	1.73	6	1.33	1.41	1.38	4	1.05	1.43	1.30	6	0.99	1.61	1.37	92	1.40	135
All groups			1.46	123			1.63	28			1.40	5			1.31	11			1.34	126	1.42	293
<u>Speckled dace</u>																						
0-60	0.57	1.73	1.09	119	0.88	1.09	0.97	9	0.83	1.44	1.04	23	0.78	1.12	1.02	14	0.70	1.22	1.03	23	1.07	183
>61	0.74	0.95	0.85	2	0.93	1.02	1.02	13	0.91	1.58	1.17	14	0.88	1.37	0.98	20	0.67	1.20	1.02	250	1.02	292
All groups			1.09	121			1.04	22			1.09	37			0.99	34			1.02	273	1.04	487

¹ $\bar{x}$ = mean

²N = number of specimens

As stated previously, one important aspect of condition factors is their utility in monitoring environmental perturbations or pollution. The present year's data, when supplemented by an additional year of data, should provide a good baseline for monitoring any subsequent changes in condition.

d. Food Habits

1) Flannemouth sucker - Major emphasis was placed upon the food habits of the flannemouth sucker. A summary of stomach content analyses done through September 1975 is given in Table 3-8-230.

Immature aquatic insects, primarily midges (Chironomidae) and mayflies (Ephemeroptera), with lesser numbers of black flies (Simuliidae), caddisflies (Trichoptera) and other insects, comprised the major portion of the diet of the flannemouth sucker. Some differences in relative abundance of major food items were observed with season. The frequency of occurrence of both Ephemeroptera and Chironomidae was lower in June and July 1975, with a slight increase in September 1975. These groups also occurred in reduced numbers in the benthos samples in June and July and in slightly increased numbers in September. The occurrence of these organisms in flannemouth sucker stomachs appears related to their availability in the environment. In general, the Chironomidae and Ephemeroptera metamorphose into the adult form and emerge from the water in the spring and early summer, thus greatly reducing their availability as fish forage.

In evaluating the contributions of the various insect groups to the fish diet, care must be taken in assigning "importance" to certain groups. The Chironomidae were consistently found in the greatest number of stomachs and in the greatest abundance. However, the large number of individual Chironomidae present is deceptive because of the relatively small size of these organisms. For example, in April 1975, chironomids constituted 63% of the total food items in all stomachs. The stoneflies (Plecoptera), mayflies (Ephemeroptera) and caddisflies (Trichoptera) together constituted 35% and occurred in a high percentage of stomachs. The greater relative size of

Table 3-8-230. Summary of food habit analyses for flannelmouth suckers taken at the RBOSP site from October through September 1975.

<u>food type</u>	<u>October 1974 (5 specimens)</u>		<u>April 1975 (56 specimens)</u>		<u>June 1975 (52 specimens)</u>	
	<u>% frequency of occurrence</u>	<u>% of total food items</u>	<u>% frequency of occurrence</u>	<u>% of total food items</u>	<u>% frequency of occurrence</u>	<u>% of total food items</u>
Nematoda	-	-	11	<1	2	<1
Crustacea	-	-	-	-	-	-
Acari	-	-	18	<1	-	-
Plecoptera	40	45	68	3	8	1
Ephemeroptera	60	31	98	28	44	25
Odonata	-	-	2	<1	-	-
Trichoptera	20	1	80	4	23	8
Hydropsychidae	40	4	73	3	21	8
Hydroptilidae	-	-	39	<1	4	<1
others	-	-	5	<1	-	-
Lepidoptera	20	<1	18	<1	2	<1
Coleoptera	-	-	2	<1	-	-
Diptera						
Chironomidae	80	1	100	63	65	52
Simuliidae	60	14	23	<1	17	9
others	20	2	45	1	8	1
Pelecypoda	-	-	-	-	-	-
adult (terrestrial) insects	-	-	9	<1	8	1
algae	-	-	-	-	-	-
plant material	-	-	2	-	21	-

3-8-670

Table 3-8-230 (Continued)

<u>food type</u>	<u>July 1975 (67 specimens)</u>		<u>September 1975 (114 specimens)</u>	
	<u>% frequency of occurrence</u>	<u>% of total food items</u>	<u>% frequency of occurrence</u>	<u>% of total food items</u>
Nematoda	3	<1	-	-
Crustacea	1	25	8	1
Acari	16	<1	4	<1
Plecoptera	6	<1	<1	<1
Ephemeroptera	12	4	26	5
Odonata	3	<1	-	-
Trichoptera	25	9	-	-
Hydropsychidae	19	8	33	8
Hydroptilidae	4	<1	8	<1
others	12	<1	4	<1
Lepidoptera	3	<1	<1	<1
Coleoptera	6	<1	-	-
Diptera				
Chironomidae	52	52	95	84
Simuliidae	3	<1	13	<1
others	15	<1	4	<1
Pelecypoda	-	-	<1	<1
adult (terrestrial) insects	25	6	4	<1
algae	21	-	6	-
plant material	33	-	6	-

3-8-671

the latter organisms (at least ten-fold and up to 100-fold in some cases) indicates that the greater portion of the diet, in terms of biomass or caloric intake, was made up of immature stoneflies, mayflies and caddisflies. The same condition existed in June, July and September, but to a lesser degree. The low frequency of occurrence of mayflies and caddisflies in June, July and September suggests that Chironomidae and other items were relatively more important (biomass) in these months than in April.

Plant material and algae occurred in significant numbers of stomachs in June and July. Plant material consisted of seeds and pieces of higher plant tissue, often clearly terrestrial in origin. Algae were filamentous. One reason for this has to be availability. Filamentous algae were more abundant during the latter half of the summer and early fall (see Section 8.2C, Periphyton). Also, plants of terrestrial origin would presumably be more available at this time because of hay cutting operations that took place in fields adjacent to the river several times during the summer. The increased consumption of plant material and algae may also have been related to the reduced availability of insects at this time. The increased consumption of plant material by bluegill (Lepomis macrochirus) during periods of reduced insect availability has been reported by several investigators (Scott and Crossman, 1973). This may be the case with the flannelmouth sucker since plant consumption decreased in September when insects showed an increase, while algae and, presumably, other plant material were still abundant.

The results of the food habit analysis of the flannelmouth sucker is especially significant in light of what has been reported in the literature about the food habits of this species. Since Jordan (1891) reported that the stomach of one specimen contained filamentous algae and other vegetation, the species has been considered herbivorous. Jordan and Evermann (1896) listed the species as herbivorous. Ellis (1914) cited the earlier opinion of Jordan and Evermann, and also presented stomach data for nine specimens from the Grand and Uncompahgre Rivers in western Colorado. Seven of these specimens contained plant material of some type, algae, higher plant fragments, or seeds. Two specimens contained only "slime". McDonald and Dotson (1960) reported that the stomachs of four flannelmouth suckers taken from the

Colorado River in Utah contained algae and unidentifiable material. Later authors, apparently relying on these earlier reports, listed the flannelmouth sucker as completely or largely herbivorous (Koster, 1957; Sigler and Miller, 1963; Carlander, 1969; Everhart and Seaman, 1971). The only dissenting opinion has been that of Minckley (1973) who stated in his book, "Fishes of Arizona", that the flannelmouth sucker "feeds extensively on bottom invertebrates" in the Salt River, but presented no stomach analysis data.

Although it is difficult to extrapolate food habits from one area to another, it appears that, with the data from the present food habit analyses of flannelmouth suckers, and Minckley's (1973) notation, the classification of this species as herbivorous is in error. It appears that the herbivorous classification was derived from examination of only 14 specimens (Jordan, 1891; Ellis, 1914; and McDonald and Dotson, 1960). At least 13 of these 14 specimens were captured in July and August, a time when the White River specimens (present study) ingested significantly more plant material. It is not surprising, then, that because of the small number of specimens previously examined, and the time of the year when they were captured, that the literature reports that the flannelmouth sucker is a herbivore.

2) Mottled sculpin - Mottled sculpin fed primarily on mayflies, caddisflies, and stoneflies: Hydropsychidae (Trichoptera) were dominant in October 1974, Ephemeroptera in April and June 1975, and Hydropsychidae in September 1975 (Table 3-8-231). No clear trends were shown in July because of the small number of specimens examined. Although seasonal trends were evident, the causes were difficult to establish. Stoneflies (Plecoptera), primarily the genus Isoperla, were significant in the diet only in April. This taxon also showed the same pattern of abundance in the benthos samples (see Section 8.2D, Benthos). Also, the largest instars of this taxon were available in April, and were presumably more vulnerable to predation by sculpins. Hydropsychidae were abundant in the stomachs in October 1974 and September 1975 and low in the summer. This generally corresponds to their abundance in the environment. However, hydropsychids were quite low in April stomachs, at a time when there appeared to be reasonable numbers in the environment. This may have been due to sculpins actively selecting

Table 3-8-231. Summary of food habit analyses for mottled sculpin taken at the RBOSP site from October 1974 through September 1975.

<u>food type</u>	<u>October 1974 (23 specimens)</u>		<u>April 1975 (23 specimens)</u>		<u>June 1975 (10 specimens)</u>	
	<u>% frequency of occurrence</u>	<u>% of total food items</u>	<u>% frequency of occurrence</u>	<u>% of total food items</u>	<u>% frequency of occurrence</u>	<u>% of total food items</u>
Crustacea	-	-	-	-	-	-
Oligochaeta	13	2	4	<1	-	-
Plecoptera	-	-	83	28	10	2
Ephemeroptera	52	32	83	62	91	86
Odonata	4	<1	-	-	-	-
Trichoptera	87	44	17	2	30	8
Hydropsychidae	87	44	17	2	30	8
other	-	-	-	-	-	-
Lepidoptera	4	<1	-	-	-	-
Coleoptera	4	<1	4	2	-	-
Diptera						
Chironomidae	52	17	26	6	-	-
Simuliidae	9	2	-	-	-	-
other	9	<1	-	-	-	-
Hemiptera						
Corixidae	-	-	-	-	-	-
Fish	4	<1	-	-	-	-

3-8-674

Table 3-8-231 (Continued)

<u>food type</u>	<u>July 1975 (5 specimens)</u>		<u>September 1975 (81 specimens)</u>	
	<u>% frequency of occurrence</u>	<u>% of total food items</u>	<u>% frequency of occurrence</u>	<u>% of total food items</u>
Crustacea	-	-	2	<1
Oligochaeta	-	-	-	-
Plecoptera	-	-	-	-
Ephemeroptera	20	13	35	5
Odonata	-	-	-	-
Trichoptera	20	13	78	50
Hydropsychidae	-	-	74	47
other	20	13	9	2
Lepidoptera	-	-	6	<1
Coleoptera	-	-	2	<1
Diptera				
Chironomidae	40	63	75	42
Simuliidae	-	-	7	<1
other	20	13	2	<1
Hemiptera				
Corixidae	-	-	2	<1
Fish	-	-	12	-

3-8-675

mayflies and stoneflies. Dunlevy (unpublished manuscript) showed that mottled sculpins exhibit some degree of selectivity in feeding. Also, the preponderance of mayflies in the stomachs of nine of ten fish taken in June suggests selective feeding because the abundance of mayflies in the river had decreased greatly from April to June.

Fish remains were found in the stomachs of one mottled sculpin in October 1974 and 10 fish in September 1975. Fish generally constitute only a small part of the diet of mottled sculpins as a group. Bailey (1952) reported fish remains in only five of 768 sculpins from the West Gallatin River, Montana. Fish were relatively more important in the diet of White River mottled sculpins, at least in September 1975, with 10 of 81 specimens containing fish remains. Only the larger sculpins consumed fish in both studies (fish greater than 66 mm and 80 mm in the White River and West Gallatin River, respectively). The mean length of the 10 White River specimens was 89 mm.

The general benthic feeding habits of the mottled sculpin agree with the findings of earlier investigators as reviewed by Bailey (1952) and Scott and Crossman (1973). However, sculpins in the West Gallatin River (Bailey, 1952) relied more on chironomids and less on ephemeropterans than those in the White River (present RBOSP study). Although relative numbers of chironomids consumed by West Gallatin River sculpins was greater, the great size differential of Ephemeroptera and Trichoptera versus Chironomidae suggests that the former constituted the bulk of the nutritional material ingested.

3) Bluehead sucker - Stomach analyses were made on a relatively few specimens (Table 3-8-234). The small quantity of data obtained omnivorous feeding habits for this species, since both plant and animal material was found in stomachs of this species. The amount of vegetable material consumed may not be adequately expressed in the data, however. Examination of the stomachs of the six specimens collected in April 1975 revealed no insects or other animal material. The stomach contents (in several cases, the stomachs

Table 3-8-232. Summary of food habit analyses for bluehead suckers taken at the RBOSP during April through September 1975.

	<u>April 1975 (6 specimens)</u>		<u>June 1975 (6 specimens)</u>		<u>July 1975 (5 specimens)</u>		<u>September 1975 (1 specimen)</u>	
	<u>% frequency of occurrence</u>	<u>% of total food items</u>	<u>% frequency of occurrence</u>	<u>% of total food items</u>	<u>% frequency of occurrence</u>	<u>% of total food items</u>	<u>% frequency of occurrence</u>	<u>% of total food items</u>
Ephemeroptera								
Baetidae	-	-	50	36	-	-	-	-
Diptera								
Chironomidae	-	-	33	46	60	99	100	100
Simuliidae	-	-	17	13	-	-	-	-
Trichoptera								
Hydroptilidae	-	-	17	3	-	-	-	-
Lepidoptera								
Pyrilidae	-	-	17	3	-	-	-	-
terrestrial insects	-	-	-	-	20	1	-	-
algae	100	-	-	-	-	-	-	-
plant material	-	-	17	-	40	-	-	-

3-8-677

were nearly full) were then processed, mounted on glass slides and examined under high magnification. This examination revealed large numbers of diatoms, primarily Navicula viridula. This species was also dominant in the river at that time.

Although giving no stomach analysis data, Smith (1966) states that the long, coiled intestine and cartilaginous scraping edge of the lower lip suggest herbivorous feeding habits for the bluehead sucker.

4) Other Species - Stomach analyses data for roundtail chub, carp, mountain whitefish, rainbow and brown trout are presented in Tables 3-8-233 through 3-8-236. Little interpretation can be made because of the limited numbers of specimens examined. The results appear to follow what has previously been established for these species, that is, mountain whitefish and carp are benthic feeders, the trout are both benthic and surface feeders, and roundtail chubs take benthic, drifting and swimming organisms including fish.

e. Reproduction - Some insight into the reproductive status of fishes was made through observation of gonad condition and presence of young-of-year fishes. Because of the existence of more data on flannelmouth suckers, this species is discussed individually.

1) Flannelmouth sucker - Examination of the gonads of flannelmouth suckers revealed that the fish did not attain sexual maturity until they had grown to around 400 mm in length. Although sex could be determined in the field on some specimens over 300 mm, most of these had obviously underdeveloped gonads. In April 1975, eight mature males were captured that ranged from 351 mm to 474 mm in length (mean = 421 mm). Nine mature females averaged 443 mm and ranged from 413 mm to 480 mm. One possible underdeveloped male was recorded at 403 mm and three obvious but quite underdeveloped females at 368, 382 and 406 mm.

Table 3-8-233. Summary of stomach content analyses for roundtail chub taken at the RBOSP site in June, July and September 1975.

	<u>June 1975 (4 specimens)</u>	<u>July 1975 (3 specimens)</u>	<u>September 1975 (4 specimens)</u>
	<u>% frequency of occurrence</u>	<u>% frequency of occurrence</u>	<u>% frequency of occurrence</u>
Acari	25	-	-
Ephemeroptera			
Baetidae	25	-	-
Diptera			
Chironomidae	75	33	-
Tabanidae	-	33	-
Trichoptera			
Hydropsychidae	25	-	25
terrestrial insects	-	-	75
fish	25	67	-
algae	75	-	25
plant material	-	33	75

Table 3-8-234. Summary of food habit analyses for mountain whitefish taken at the RBOSP site in April and September 1975.

	<u>April 1975 (2 specimens)</u>		<u>September 1975 (8 specimens)</u>	
	<u>% frequency of occurrence</u>	<u>% of total food items</u>	<u>% frequency of occurrence</u>	<u>% of total food items</u>
Nematoda	-	-	13	<1
Acari	100	<1	-	-
Ephemeroptera	100	7	100	15
Trichoptera				
Hydropsychidae	100	55	100	20
Hydroptilidae	50	<1	50	2
Diptera				
Chironomidae	100	37	100	61
Ceratopogonidae	50	<1	-	-
Simuliidae	-	-	13	<1
Plecoptera				
<u>Isoperla</u>	100	<1	-	-
Lepidoptera				
Pyralidae	50	<1	38	<1
Terrestrial insects	-	-	13	<1

Table 3-8-235. Summary of food habit analyses for rainbow trout taken at the RBOSP site in October 1974 and April 1975.

	<u>October 1974 (1 specimen)</u>		<u>April 1975 (4 specimens)</u>	
	<u>% frequency of occurrence</u>	<u>% of total food items</u>	<u>% frequency of occurrence</u>	<u>% of total food items</u>
Ephemeroptera				
Baetidae	100	12	75	16
Heptageniidae	100	3		
Plecoptera				
<u>Isoperla</u>	-	-	75	4
Odonata				
Coenagrionidae	100	5	100	39
Aeshnidae	-	-	25	<1
Diptera				
<u>Limnophora</u>	-	-	75	16
Simuliidae	-	-	75	9
Tabanidae	-	-	50	5
Chironomidae	-	-	50	2
Tipulidae	-	-	25	2
Hemiptera				
Corixidae	100	66	50	5
Notonectidae	100	2		
Coleoptera				
Dystiscidae	-	-	50	2
Terrestrial (or adult) insects	100	8	25	<1
algae	100	-	-	-

3-8-681

Table 3-8-236. Summary of stomach content analyses for carp and brown trout taken at RBOSP during September 1975.

<u>Carp September 1975 (7 specimens)</u>		
	<u>% frequency of occurrence</u>	<u>% of total food items</u>
Diptera		
Chironomidae	100	99
Odonata		
Gomphidae	14	<1
Ephemeroptera	14	<1
plant material	14	-
 <u>Brown trout September 1975 (1 specimen)</u>		
	<u>% frequency of occurrence</u>	<u>% of total food items</u>
Diptera		
Chironomidae	100	67
Trichoptera		
Hydropsychidae	100	7
Odonata		
Coenagrionidae	100	7
terrestrial insects	100	20

That spawning of flannelmouth suckers took place between the April and May - June 1975 samplings was suggested by the obviously spent condition of mature fish captured during June. Four females, 422 to 472 mm, were obviously spent as were two males at 411 and 434 mm. Five females, 345 to 364 mm, were recorded as either spent or immature, which condition could not be determined. Two males at 423 and 429 mm, although largely spent, still released some milt with pressure.

Although relatively few specimens were examined, it appears probable that spawning of the flannelmouth sucker takes place sometime during May and June, and probably largely in June judging from the condition of the gonads. The temperature at which spawning takes place appears to be around 12-13°C, the temperature recorded for the White River in both April and June 1975. There is apparently no published information on the spawning time or temperature for the flannelmouth sucker.

2) Young-of-year fish - The presence of young-of-year fish in late season is the first indication of successful reproduction in a given year. Although relatively large numbers of adults indicate successful reproduction in general, a given year's success can only be measured by the recruitment of young-of-year fish late in the season. A significant number of young-of-year fish, primarily flannelmouth, bluehead suckers and speckled dace appeared in the study area in September 1975. These fish were captured mostly in near-shore, quiet-water areas and in back channel habitats. Also, many young-of-year suckers and dace were observed in cutoff pools and channels that were not part of the normal sampling stations.

In summary, fish were found only in the White River and, to some extent, in Yellow Creek. In the present study area, the fishery habitat of the White River appeared to be intermediate between cold and warm water habitats, as suggested by the mixture of cold and warm water species observed there. The high water temperatures which have occurred periodically and the high turbidities which occurred in these waters undoubtedly restricted the occurrence and abundance of trout species. The fishery of this area of the White River was thus dominated by rough and forage species. A total of 15 fish species and one hybrid form was observed in the White River and Yellow Creek during RBOSP aquatic studies. The most common species were flannelmouth suckers, bluehead sucker, speckled dace, fathead minnow, and mottled sculpin. The fish existing at the site comprise a mixture of consumer groups, although most were secondary consumers. Food habit studies of the most abundant fish species in the area indicate that benthic invertebrates belonging to the Chironomidae, Plecoptera, Ephemeroptera, and Trichoptera comprised the major portion of the diet of those species. The relative importance of specific macroinvertebrate groups in the fish diet varied somewhat according to season and with the abundance of the invertebrates.

In general, few fish were observed in Yellow Creek. The brackish nature of Yellow Creek, particularly the high concentrations of sodium and chloride along with the limited habitat available and periodic high temperatures, generally restricted the occurrence of fish. However, during the period of maximum flow in the White River, a large backwater area was created near the mouth of Yellow Creek and a considerable increase in the number of species and individuals was observed.

5. Threatened and endangered species

No rare or endangered fishes were encountered during the present RBOSP baseline study. However, two species that are considered rare or endangered, bonytail and Colorado squawfish, were previously captured near the present study area by Everhart and May (1973).

The bonytail is very rare throughout the Colorado River Basin (Holden and Stalnaker, 1975b). Everhart and May (1973) reported the bonytail in the White River during 1969. Seaman (1962) indicated that bonytail occurred 50 miles upstream in the White River from the Colorado state line, a distance that would include the RBOSP study area. However, it is not clear what species Seaman was referring to since prior to 1970, the name "bonytail" was often used to refer to both forms now known as Gila robusta and Gila elegans, (e.g., Eddy, 1957; Sigler and Miller, 1963; Smith, 1960). Behnke (unpublished manuscript) indicated that the status of the bonytail in the White River was unknown, but that it may be declining as in the Yampa and Green Rivers.

Everhart and May (1973) also recorded Colorado squawfish near the RBOSP study area. This species is listed as "endangered" by the U.S. Department of the Interior (1974). This species has been drastically reduced in abundance in the Colorado River Basin, apparently due to dam construction. One of the last significant populations of this species, in the Green and Yampa rivers, is experiencing poor reproductive success, and may be in decline (Behnke, unpublished manuscript; Holden and Stalnaker, 1975b). Behnke (unpublished manuscript) indicated that the Colorado squawfish is "evidently rare or virtually gone" from the White River. May (personal communication) indicated that the Colorado squawfish captured in the White River during 1969 (Everhart and May, 1973) were few in number and were encountered upstream from the RBOSP study area.

8.3 STATISTICS

A. Confidence Limits - for the RBOSP Aquatic Sampling Program confidence limits to means of selected chemical and biological parameters were calculated for certain geographic locations for each sampling date. These limits are the upper and lower boundaries of the confidence interval of the mean and imply that the probability of the interval covering the mean is 0.95.

In constructing the confidence limit for RBOSP Aquatic Program, an analysis of variance table was constructed. From this table the error mean square for testing the interaction between the sampling dates and geographic regions was the nested interaction term of sampling date with sampling sites nested within geographic regions. This analysis was not used for testing purposes. It does, however, provide an estimate of this latter mean square to use in calculating the standard errors for the confidence limits for each geographic region by sampling date. These standard errors were then multiplied by the appropriate t-value and the upper and lower boundaries for the confidence interval were determined.

The method used in calculating the confidence limits was to group the sampling locations for each of the six (6) sampling dates and then to perform an analysis of variance on the selected parameters. The calculated mean squares from these analyses were used in constructing the limits.

The sampling locations were grouped as follows:

<u>Region</u>	<u>Sampling Location</u>
1	1-5
2	6-18
3	18-22
4	23-27
5	28-29
6	30-35

With the above sampling locations defining six (6) regions, the following analysis of variance was performed:

<u>Source of Variation</u>	<u>Mean Square</u>
Region	MSR
Date (Region)	MSS (R)
Date	MSD
Date * Region	MSDR
Date * Site (Region)	MSDS (R)
Error	MSE
Total	

The MSDS (R) mean square was used as the variance of the mean for each date by region mean, and thus, all standard errors for each parameter were constructed using this mean square. That is,

$$\text{Standard Error} = \sqrt{\frac{\text{MSDS (R)}}{n}}$$

where n is the number of observations for each mean.

To calculate the upper and lower limits for the confidence interval, the standard error of the mean was multiplied by the appropriate t-value. All t-values were determined at the 0.05 level of significance and are as follows:

<u>Data Type</u>	<u>Degrees of Freedom</u>	<u>t-value</u>
Phytoplankton	99	1.984
Periphyton	99	1.984
Zooplankton	101	1.983
Benthos	69	1.995
Water Chemistry	103	1.983
Sediment Chemistry	103	1.983

Thus, the limits were calculated as

(LL, UL)

where LL = lower confidence limit = $x - t(0.05, df) SE$

UL = upper confidence limit = $x + t(0.05, df) SE$

$t(0.05, df)$ = t-value at 0.05 level of significance with
df degrees of freedom

SE = Standard Error of Mean

For the RBOSP fish program, confidence limits to means of selected fish parameters were calculated. These limits are the upper and lower boundaries of the confidence interval of the mean and imply that the probability of the interval covering the mean is 0.95. The method used in calculating standard errors and thus confidence limits for the fish catch data was to calculate the variance of the parameters for the combined effort. This term was then used in calculating the standard errors and thus the confidence intervals for each parameter. That is,

$$\text{Standard Error} = \sqrt{\frac{\text{variance}}{n}}$$

$$\text{variance} = \frac{1}{n-1} \left[\sum_{i=1}^n x_i^2 - n(\bar{x})^2 \right]$$

To calculate the upper and lower limits of the confidence interval, the standard error of the mean was multiplied by a t-value. All t-values were determined at the 0.05 level of significance, and are as follows:

<u>stations</u>	<u>degrees of freedom</u>	<u>t-value</u>
20-24, 26-30, 32-35	4	2.776
25 and 31	3	3.182

Confidence limits for the parameters discussed above are presented in Section 3.3 of the Environmental Baseline Studies, Annual Report for 1975 (RBOSP, 1976). In this report observational data have been presented for certain parameters (e.g., aquatic macrophytes) where confidence intervals have not been generated. In those cases, the data are important in describing the existing aquatic habitats.

B. Diversity Indices - Diversity indices are a measure of the variability for the information of a species.

1. Shannon Index:

The formula for the Shannon index is:

$$H' = -\sum p_i \log p_i$$

where $p_i = N_i/N$

N_i = amount of information for the i^{th} species

N = amount of information for the whole sample.

This index was proposed by Shannon as a measure of the information content of code. However, ecologists currently are using it as a measure of a community's diversity.

2. Shannon Evenness Index:

The formula for this index is:

$$J' = H'/H'_{\max}$$

where $H' =$ Shannon Index

$H'_{\max} = \log s$, s = total number of species in the sampled community. The evenness index is a measure of how well the individuals are apportioned among the species. It is the ratio of the observed diversity index to the maximum value the index could have in a community with the same number of species.

3. Richness

The formula for this index is:

$$d = (S-1)/\log N$$

where S = total number of species in the sampled community

N = total number of individuals in the sampled community.

This index is a measure of species richness component of diversity, and weights species number more than total abundance (N).

Shannon functions serve well in biological analyses because they are robust and their distributions are well known.

C. Statistical Data - Confidence limits to means of chemical parameters are presented in Table 3-8-237, whereas, those for periphyton, phytoplankton, zooplankton, benthos, fish and sediment chemistry are presented in Tables 3-8-238, 3-8-239, 3-8-240, 3-8-241, 3-8-242 and 3-8-243 respectively. At the present time, confidence limits for certain other parameters are being determined; these will be incorporated in an addendum to this report. Diversity indices were presented and discussed in Sections 8.2C, Periphyton, and 8.2D, Benthos.

Table 3-8-237 Rio Blanco Oil Shale Project Aquatic Baseline Studies, confidence limits for water quality data for each region and date mean (sequence = mean, confidence limits and number samples).

Chloride

MSDS(R) = 86.462							max. $\bar{x}$ = 129.25	min. $\bar{x}$ = 6.93
Date	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6		
110074	7.90 (2.07, 13.73) 10	9.90 (4.07, 15.73) 10	83.00 (76.43, 89.52) 8	31.50 (25.67, 37.33) 10	32.25 (23.03, 41.47) 4	32.75 (27.43, 38.07) 12		
010075	10.67 (3.14, 18.20) 6	11.63 (5.11, 18.15) 8	101.00 (94.48, 107.52) 8	39.30 (33.47, 45.13) 10	40.75 (31.53, 49.97) 4	39.75 (34.43, 45.07) 12		
040075	6.93 (1.10, 12.76) 10	9.22 (3.39, 15.05) 10	87.75 (81.23, 94.27) 8	28.20 (22.37, 34.03) 10	35.75 (26.53, 44.97) 4	28.83 (23.51, 34.15) 12		
060075	7.90 (2.07, 13.73) 10	11.83 (6.51, 17.15) 12	110.88 (104.36, 117.40) 8	9.20 (3.37, 15.03) 10	10.50 (1.28, 19.72) 4	9.17 (3.85, 14.49) 12		
070075	17.30 (11.47, 23.13) 10	17.00 (12.39, 21.61) 16	116.63 (110.11, 123.15) 8	30.00 (24.17, 35.83) 10	22.25 (13.03, 31.47) 4	22.17 (16.85, 27.49) 12		
080075	7.44 (1.61, 13.27) 10	12.00 (7.07, 16.93) 14	129.25 (122.73, 135.77) 8	32.20 (26.37, 38.03) 10	34.50 (25.28, 43.72) 4	32.92 (27.60, 38.24) 12		

Table 3-8-237 (Continued)

Hardness

MSDS(R) = 2890.723

max. $\bar{x}$ = 600.00min. $\bar{x}$ = 150.00

Date	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6
110074	479.00 (445.28, 512.72) 10	498.00 (464.28, 531.72) 10	595.00 (557.31, 632.69) 8	274.50 (240.78, 308.22) 10	275.00 (221.69, 328.31) 4	269.17 (238.39, 299.95) 12
010075	570.67 (527.14, 614.20) 6	529.63 (491.94, 567.32) 8	595.38 (557.69, 633.07) 8	297.30 (263.58, 331.02) 10	291.00 (237.69, 344.31) 4	299.83 (269.05, 330.61) 12
040075	436.00 (402.28, 469.72) 10	441.00 (407.28, 474.72) 10	595.00 (557.31, 632.69) 8	284.00 (250.28, 317.72) 10	280.00 (226.69, 333.31) 4	283.33 (252.55, 314.11) 12
060075	469.00 (435.28, 502.72) 10	469.17 (438.39, 499.95) 12	600.00 (562.31, 637.69) 8	200.00 (233.72, 160.28) 10	150.00 (93.39, 203.31) 4	168.33 (137.55, 199.11) 12
070075	452.70 (418.98, 486.42) 10	519.88 (493.23, 546.53) 16	514.38 (476.69, 552.07) 8	242.00 (208.28, 275.72) 10	251.00 (197.69, 304.31) 4	243.33 (212.55, 274.11) 12
080075	467.00 (433.28, 500.72) 10	495.93 (465.15, 526.71) 12	512.75 (475.06, 550.44) 8	279.20 (245.58, 312.92) 10	272.25 (218.94, 325.56) 4	281.08 (250.30, 311.86) 12

Table 3-8-237 (Continued)

Magnesium

MSDS(R) = 244.499

max. $\bar{x}$ = 141.25min. $\bar{x}$ = 11.10

Date	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6
110074	56.60 (47.20, 66.00) 10	64.20 (54.80, 73.60) 10	117.50 (107.00, 128.00) 8	22.60 (13.20, 32.00) 10	23.50 (8.64, 38.36) 4	22.67 (14.09, 31.25) 12
010075	70.33 (58.20, 82.46) 6	73.25 (62.75, 83.75) 8	130.25 (119.75, 140.75) 8	29.10 (19.70, 38.50) 10	33.25 (18.39, 48.11) 4	30.08 (21.50, 38.66) 12
040075	53.40 (44.00, 62.80) 10	66.40 (57.00, 75.80) 10	141.25 (130.75, 151.75) 8	24.00 (14.60, 33.40) 10	29.00 (14.14, 43.86) 4	24.33 (15.75, 32.91) 12
060075	44.30 (34.90, 53.70) 10	44.33 (35.75, 52.91) 12	92.25 (81.75, 102.75) 8	11.10 (1.70, 20.50) 10	12.00 (0 , 26.86) 4	11.42 (2.84, 20.00) 12
070075	56.00 (46.60, 65.40) 10	79.00 (71.57, 86.43) 16	117.88 (107.38, 128.38) 8	20.80 (11.40, 30.20) 10	21.50 (6.64, 36.36) 4	21.25 (12.67, 29.83) 12
080075	57.10 (47.70, 66.50) 10	72.50 (64.56, 80.44) 14	115.13 (104.63, 125.63) 8	30.40 (21.00, 39.80) 10	32.50 (17.64, 47.36) 4	31.83 (23.25, 40.41) 12

3-8-693

Table 3-8-237 (Continued)

Nitrate

	MSDS(R) = 0.194			max. $\bar{x}$ = 1.79		min. $\bar{x}$ = .20
Date	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6
110074	0.92 (.64, 1.20) 10	0.80 (.52, 1.08) 10	1.14 (.83, 1.45) 8	0.20 (0, .48) 10	0.20 (0, .99) 4	0.20 (0, .45) 12
010075	1.02 (.66, 1.38) 6	0.99 (.68, 1.30) 8	1.79 (1.48, 2.10) 8	0.55 (.27, .83) 10	0.55 (.11, .99) 4	0.20 (.33, .83) 12
040075	0.96 (.68, 1.24) 10	0.52 (.24, .80) 10	0.68 (.37, .99) 8	0.20 (0, .48) 10	0.20 (0, .64) 4	0.20 (0, .45) 12
060075	0.88 (.60, 1.16) 10	1.00 (.75, 1.25) 12	0.20 (0, .51) 8	0.20 (0, .48) 10	0.20 (0, .64) 4	0.20 (0, .45) 12
070075	0.64 (.36, .92) 10	0.63 (.41, .85) 16	0.20 (0, .51) 8	0.20 (0, .48) 10	0.20 (0, .64) 4	0.20 (0, .45) 12
080075	0.43 (.15, .71) 10	0.35 (.12, 2.58) 14	0.20 (0, .51) 8	0.20 (0, .48) 10	0.20 (0, .64) 4	0.20 (0, .45) 12

Table 3-8-237 (Continued)

Phosphate

MSDS(R) = .00006511

max. $\bar{x}$ = 0.05min. $\bar{x}$ = 0.01

Date	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6
110074	0.01 (.00, .02) 10	0.02 (.01, .03) 10	0.01 (.00, .02) 8	0.01 (.00, .02) 10	0.01 (.00, .02) 4	0.01 (.01, .01) 12
010075	0.01 (.00, .02) 6	0.02 (.01, .03) 8	0.05 (.04, .06) 8	0.01 (.00, .02) 10	0.02 (.01, .03) 4	0.01 (.01, .01) 12
040075	0.01 (.00, .02) 10	0.02 (.01, .03) 10	0.02 (.01, .03) 8	0.01 (.00, .02) 10	0.01 (.00, .02) 4	0.01 (.01, .01) 12
060075	0.01 (.00, .02) 10	0.01 (.01, .01) 12	0.01 (.00, .02) 8	0.02 (.01, .03) 10	0.02 (.01, .03) 4	0.02 (.02, .02) 12
070075	0.02 (.01, .03) 10	0.02 (.02, .02) 16	0.01 (.00, .02) 8	0.02 (.01, .03) 10	0.03 (.02, .04) 4	0.03 (.03, .03) 12
080075	0.01 (.00, .02) 10	0.02 (.02, .02) 14	0.02 (.01, .03) 8	0.01 (.00, .02) 10	0.01 (.00, .02) 4	0.01 (.01, .01) 12

3-8-695

Table 3-8-237 (Continued)

Total Phosphate

MSDS(R) = .08562						
max. $\bar{x}$ = 0.27 min. $\bar{x}$ = 0.02						
Date	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6
110074	0.07 (0, .25) 10	0.03 (0, .21) 10	0.04 (0, .25) 8	0.03 (0, .21) 10	0.02 (0, .31) 4	0.03 (0, .20) 12
010075	0.03 (0, .27) 6	0.02 (0, .23) 8	0.08 (0, .29) 8	0.09 (0, .27) 10	0.07 (0, .36) 4	0.08 (0, .25) 12
040075	0.05 (0, .23) 10	0.46 (.28, .64) 10	0.10 (0, .31) 8	0.24 (.06, .42) 10	0.11 (0, .40) 4	0.20 (.03, .37) 12
060075	0.27 (09, .45) 10	0.70 (.53, .87) 12	0.03 (0, .24) 8	0.15 (.00, .33) 10	0.24 (0, .53) 4	0.15 (0, .32) 12
070075	0.09 (0, .27) 10	0.04 (0, .19) 16	0.04 (0, .25) 8	0.07 (0, .25) 10	0.08 (0, .37) 4	0.05 (0, .22) 12
080075	0.09 (0, .27) 10	0.17 (0, .33) 14	0.07 (0, .28) 8	0.05 (0, .23) 10	0.04 (0, .33) 4	0.04 (0, .21) 12

Table 3-8-237 (Continued)

Phosphate

	MSDS(R) = .00006511			max. $\bar{x}$ = 0.05		min. $\bar{x}$ = 0.01
Date	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6
110074	0.01 (.00, .02) 10	0.02 (.01, .03) 10	0.01 (.00, .02) 8	0.01 (.00, .02) 10	0.01 (.00, .02) 4	0.01 (.01, .01) 12
010075	0.01 (.00, .02) 6	0.02 (.01, .03) 8	0.05 (.04, .06) 8	0.01 (.00, .02) 10	0.02 (.01, .03) 4	0.01 (.01, .01) 12
040075	0.01 (.00, .02) 10	0.02 (.01, .03) 10	0.02 (.01, .03) 8	0.01 (.00, .02) 10	0.01 (.00, .02) 4	0.01 (.01, .01) 12
060075	0.01 (.00, .02) 10	0.01 (.01, .01) 12	0.01 (.00, .02) 8	0.02 (.01, .03) 10	0.02 (.01, .03) 4	0.02 (.02, .02) 12
070075	0.02 (.01, .03) 10	0.02 (.02, .02) 16	0.01 (.00, .02) 8	0.02 (.01, .03) 10	0.03 (.02, .04) 4	0.03 (.03, .03) 12
080075	0.01 (.00, .02) 10	0.02 (.02, .02) 14	0.02 (.01, .03) 8	0.01 (.00, .02) 10	0.01 (.00, .02) 4	0.01 (.01, .01) 12

Table 3-8-237 (Continued)

Total Phosphate

Date	MSDS(R) = .08562			max. $\bar{x}$ = 0.27		min. $\bar{x}$ = 0.02
	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6
110074	0.07 (0, .25) 10	0.03 (0, .21) 10	0.04 (0, .25) 8	0.03 (0, .21) 10	0.02 (0, .31) 4	0.03 (0, .20) 12
010075	0.03 (0, .27) 6	0.02 (0, .23) 8	0.08 (0, .29) 8	0.09 (0, .27) 10	0.07 (0, .36) 4	0.08 (0, .25) 12
040075	0.05 (0, .23) 10	0.46 (.28, .64) 10	0.10 (0, .31) 8	0.24 (.06, .42) 10	0.11 (0, .40) 4	0.20 (.03, .37) 12
060075	0.27 (09, .45) 10	0.70 (.53, .87) 12	0.03 (0, .24) 8	0.15 (.00, .33) 10	0.24 (0, .53) 4	0.15 (0, .32) 12
070075	0.09 (0, .27) 10	0.04 (0, .19) 16	0.04 (0, .25) 8	0.07 (0, .25) 10	0.08 (0, .37) 4	0.05 (0, .22) 12
080075	0.09 (0, .27) 10	0.17 (0, .33) 14	0.07 (0, .28) 8	0.05 (0, .23) 10	0.04 (0, .33) 4	0.04 (0, .21) 12

Table 3-8-237 (Continued)

Potassium

	MSDS(R) = .4431			max. $\bar{x}$ = 7.84		min. $\bar{x}$ = 1.51
Date	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6
110074	2.63 (2.21, 3.05) 10	2.62 (2.20, 3.04) 10	6.91 (6.44, 7.38) 8	2.42 (2.00, 2.84) 10	2.50 (1.84, 3.16) 4	2.47 (2.09, 2.85) 12
010075	2.25 (1.71, 2.79) 6	2.71 (2.24, 3.18) 8	6.89 (6.42, 7.36) 8	3.13 (2.71, 3.55) 10	3.28 (2.62, 3.94) 4	3.08 (2.70, 3.46) 12
040075	2.47 (2.05, 2.89) 10	3.55 (3.13, 3.97) 10	7.84 (7.37, 8.31) 8	2.67 (2.25, 3.09) 10	2.95 (2.29, 3.61) 4	2.72 (2.34, 3.10) 12
060075	2.18 (1.76, 2.60) 10	2.51 (2.13, 2.89) 12	6.33 (5.86, 6.80) 8	1.51 (1.09, 1.93) 10	1.53 (.87, 2.19) 4	1.53 (1.15, 1.91) 12
070075	2.36 (1.94, 2.78) 10	4.24 (3.91, 4.57) 16	6.63 (6.16, 7.10) 8	2.34 (1.92, 2.76) 10	2.28 (1.62, 2.94) 4	2.20 (1.82, 2.58) 12
080075	2.11 (1.69, 2.53) 10	2.89 (2.54, 3.24) 14	5.35 (4.88, 5.82) 8	2.49 (2.07, 2.91) 10	2.48 (1.82, 3.14) 4	2.53 (2.15, 2.91) 12

3-8-697

Table 3-8-237 (Continued)

Calcium

MSDS(R) = 85.735

max $\bar{x}$ = 105.33min. $\bar{x}$ = 19.50

Date	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6
110074	98.50 (92.69, 104.31) 10	93.00 (87.19, 98.81) 10	45.63 (39.14, 52.12) 8	72.30 (66.49, 78.11) 10	71.50 (62.32, 80.68) 4	70.75 (65.45, 76.05) 12
010075	105.33 (97.83, 112.83) 6	89.38 (82.89, 95.87) 8	44.88 (38.39, 51.37) 8	78.70 (72.89, 84.51) 10	82.50 (73.32, 91.68) 4	82.17 (76.87, 87.47) 12
040075	92.10 (86.29, 97.91) 10	78.80 (72.99, 84.61) 10	26.00 (19.51, 32.49) 8	65.40 (59.59, 71.21) 10	63.00 (53.82, 72.18) 4	63.17 (57.87, 68.47) 12
060075	90.00 (84.19, 95.81) 10	80.67 (75.37, 85.97) 12	26.25 (19.76, 32.74) 8	39.50 (33.69, 45.31) 10	36.00 (26.82, 45.18) 4	39.42 (34.12, 44.72) 12
070075	90.00 (84.19, 95.81) 10	97.50 (92.91, 102.09) 16	19.50 (13.01, 25.99) 8	63.00 (57.19, 68.81) 10	63.00 (52.82, 72.18) 4	62.50 (57.20, 67.80) 12
080075	90.90 (85.09, 96.71) 10	88.14 (83.23, 93.05) 14	20.75 (14.25, 27.24) 8	70.10 (64.29, 75.91) 10	66.50 (57.32, 75.68) 4	69.33 (64.03, 74.63) 12

Table 3-8-237 (Continued)

Turbidity

MSDS(R) = 13630.00

max $\bar{x}$ = 291.69min. $\bar{x}$ = 0.98

Date						
110074	6.10 (0, 79.31) 10	5.10 (0, 78.31) 10	11.50 (0, 94.35) 8	7.80 (0, 81.01) 10	7.50 (0, 123.26) 4	8.67 (0, 75.50) 12
010075	1.38 (0, 95.89) 6	0.98 (0, 82.83) 8	24.75 (0, 106.60) 8	38.00 (0, 111.21) 10	32.50 (0, 148.26) 4	27.50 (0, 94.33) 12
040075	9.80 (0, 83.01) 10	291.69 (218.48, 364.90) 10	59.00 (0, 140.85) 3	77.20 (3.99, 150.41) 10	49.75 (0, 165.51) 4	79.67 (12.84, 146.50) 12
060075	21.94 (0, 95.15) 10	245.67 (178.84, 312.50) 12	5.84 (0, 87.69) 8	46.10 (0, 119.31) 10	47.25 (0, 163.01) 4	48.17 (0, 115.00) 12
070075	13.71 (0, 91.92) 10	3.85 (0, 61.73) 16	12.25 (0, 94.10) 8	19.50 (0, 92.71) 10	26.25 (0, 142.01) 4	15.42 (0, 82.25) 12
080075	21.15 (0, 94.36) 10	62.21 (.34, 124.08) 14	28.13 (0, 109.98) 8	13.50 (0, 86.71) 10	21.25 (0, 137.01) 4	12.50 (0, 79.33) 12

3-8-699

Table 3-8-237 (Continued)

Sulfate

MSDS(R) = 267.20

max. $\bar{x}$ = 219.38min. $\bar{x}$ = 16.20

Date	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6
110074	82.00 (71.75, 92.25) 10	98.10 (87.85, 108.35) 10	200.13 (188.67, 211.59) 8	50.90 (40.65, 61.15) 10	51.50 (35.29, 67.71) 4	50.42 (41.06, 59.78) 12
010075	115.33 (102.10, 128.56) 6	110.88 (99.42, 122.34) 8	203.13 (191.67, 214.59) 8	55.10 (44.85, 65.35) 10	64.25 (48.04, 80.46) 4	59.58 (50.22, 68.94) 12
040075	79.30 (69.05, 89.55) 10	97.60 (87.35, 107.85) 10	219.38 (207.92, 230.84) 8	55.00 (44.75, 65.25) 10	65.50 (49.29, 81.71) 4	56.42 (47.06, 65.78) 12
060075	79.40 (69.15, 89.65) 10	81.00 (71.64, 90.36) 12	206.13 (194.67, 217.59) 8	16.20 (5.95, 26.45) 10	18.00 (1.79, 34.21) 4	16.75 (7.39, 26.11) 12
070075	60.90 (50.65, 71.15) 10	131.88 (123.78, 139.98) 16	191.88 (180.42, 203.34) 8	38.50 (28.25, 48.75) 10	41.00 (24.79, 57.21) 4	39.17 (29.81, 48.53) 12
080075	79.80 (69.55, 90.05) 10	107.00 (98.34, 115.66) 14	182.00 (193.46, 170.54) 8	50.40 (40.15, 60.65) 10	53.75 (37.54, 69.96) 4	54.00 (44.64, 63.36) 12

Table 3-8-237 Continued.

Ammonia

MSDS(R) = .0002

max $\bar{x}$ = 0.13min $\bar{x}$ = 0.09

Date	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6
110074	00.10 (.09, 0.11) 10	00.10 (0.09, 0.11) 10	00.10 (0.09, 0.11) 8	00.10 (0.09, 0.11) 10	00.10 (0.09, 0.11) 4	00.10 (0.09, 0.11) 12
010075	00.10 (0.09, 0.11) 6	00.09 (0.08, 0.10) 8	00.13 (0.12, 0.14) 8	00.10 (0.09, 0.11) 10	00.10 (0.09, 0.11) 4	00.10 (0.09, 0.11) 12
040075	00.10 (0.09, 0.11) 10	00.10 (0.09, 0.11) 10	00.10 (0.09, 0.11) 8	00.10 (0.09, 0.11) 10	00.10 (0.09, 0.11) 4	00.10 (0.09, 0.11) 12
060075	00.10 (0.09, 0.11) 10	00.10 (0.09, 0.11) 12	00.10 (0.09, 0.11) 8	00.10 (0.09, 0.11) 10	00.10 (0.09, 0.11) 4	00.10 (0.09, 0.11) 12
070075	00.10 (0.09, 0.11) 10	00.10 (0.09, 0.11) 16	00.10 (0.09, 0.11) 8	00.13 (0.09, 0.14) 10	00.10 (0.09, 0.11) 4	00.10 (0.09, 0.11) 12
080075	00.10 (0.09, 0.11) 10	00.10 (0.09, 0.11) 14	00.10 (0.09, 0.11) 8	00.10 (0.09, 0.11) 10	00.10 (0.09, 0.11) 4	00.10 (0.09, 0.11) 12

3-8-701

Table 3-8-237 Continued.

Dissolved Organic Carbon

MSDS (R) = 99.45

max $\bar{x}$ = 70.50min $\bar{x}$ = 1.25

Date	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6
110074	23.30 (17.05, 29.55) 10	19.40 (13.15, 25.65) 10	49.38 (42.39, 56.37) 8	15.20 (8.95, 21.45) 10	16.50 (6.61, 26.39) 4	15.58 (9.87, 21.29) 12
010075	10.50 (2.43, 18.57) 6	15.88 (8.89, 22.87) 8	38.53 (31.64, 45.62) 8	6.50 (0.25, 12.75) 10	7.25 (0, 17.14) 4	6.58 (0.87, 12.29) 12
040075	16.30 (10.05, 22.55) 10	23.00 (16.75, 29.25) 10	30.38 (23.39, 37.37) 8	4.70 (0, 10.95) 10	3.75 (0, 13.64) 4	13.25 (7.54, 18.96) 12
060075	10.90 (4.65, 17.15) 10	19.75 (14.04, 25.46) 12	70.50 (63.51, 77.49) 8	8.20 (1.95, 14.45) 10	7.50 (0, 17.39) 4	8.67 (2.96, 14.38) 12
070075	10.60 (4.35, 16.85) 10	10.00 (5.06, 14.94) 16	5.50 (0, 12.49) 8	4.10 (0, 10.35) 10	8.50 (0, 18.39) 4	9.75 (4.04, 15.46) 12
080075	1.30 (0, 7.55) 10	1.64 (0, 6.93) 14	1.25 (0, 8.24) 8	1.30 (0, 7.55) 10	1.25 (0, 11.14) 4	1.50 (0, 7.21) 12

Table 3-8-237 Continued.

Organic Carbon

MSDS (R) = 161.07

max $\bar{x}$ = 75.75min $\bar{x}$ = 1.00

Date	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6
10074	31.00 (23.04, 38.96) 10	25.20 (17.24, 33.16) 10	71.25 (62.35, 80.15) 8	12.50 (4.54, 20.46) 10	14.00 (1.42, 26.58) 4	13.83 (6.56, 21.10) 12
010075	16.67 (6.40, 26.94) 6	10.75 (1.85, 19.65) 8	30.00 (21.10, 38.90) 8	5.80 (0, 13.76) 10	7.50 (0, 20.08) 4	5.67 (0, 12.94) 12
040075	22.50 (14.54, 30.46) 10	35.10 (27.14, 43.06) 10	35.13 (26.23, 44.03) 8	8.10 (0.14, 16.06) 10	6.00 (0, 18.58) 4	17.50 (10.23, 24.77) 12
060075	17.70 (9.74, 25.66) 10	33.42 (26.15, 40.69) 12	75.75 (66.85, 84.65) 8	10.30 (2.34, 18.26) 10	11.50 (0, 24.08) 4	10.83 (3.56, 18.10) 12
070075	9.80 (1.84, 17.76) 10	8.69 (2.40, 14.98) 16	5.38 (0, 14.28) 8	4.30 (0, 12.26) 10	9.00 (0, 21.58) 4	9.83 (2.56, 17.10) 12
080075	2.40 (0, 10.36) 10	2.79 (0, 9.52) 14	2.25 (0, 11.15) 8	1.00 (0, 8.96) 10	1.00 (), 13.58) 4	1.00 (0, 8.27) 12

3-8-703

Table 3-8-237 Continued.

Nitrite

MSDS (R) = .00007622

max $\bar{x}$ = 0.02min $\bar{x}$ = 0.01

Date	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6
010074	0.02 (0.01, 0.03) 10	0.01 (0, 0.02) 10	0.01 (0, 0.02) 8	0.01 (0, 0.02) 10	0.01 (0, 0.02) 4	0.01 (0, 0.02) 12
010075	0.01 (0, 0.02) 6	0.01 (0, 0.02) 8	0.01 (0, 0.02) 8	0.01 (0, 0.02) 10	0.01 (0, 0.02) 4	0.01 (0, 0.02) 12
040075	0.01 (0, 0.02) 10	0.01 (0, 0.02) 10	0.01 (0, 0.02) 8	0.01 (0, 0.02) 10	0.01 (0, 0.02) 4	0.01 (0, 0.02) 12
050075	0.01 (0, 0.02) 10	0.01 (0, 0.02) 12	0.01 (0, 0.02) 8	0.01 (0, 0.02) 10	0.01 (0, 0.02) 4	0.01 (0, 0.02) 12
070075	0.02 (0.01, 0.03) 10	0.02 (0.01, 0.03) 16	0.01 (0, 0.02) 8	0.01 (0, 0.02) 10	0.01 (0, 0.02) 4	0.01 (0, 0.02) 12
080075	0.01 (0, 0.02) 10	0.01 (0, 0.02) 14	0.01 (0, 0.02) 8	0.01 (0, 0.02) 10	0.01 (0, 0.02) 4	0.01 (0, 0.02) 12

3-8-704

Table 3-8-237 Continued.

Nitrogen, Kjeldahl

	MSDS(R) = .2542		max $\bar{x}$ = 1.54		min $\bar{x}$ = 0.14	
Date	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6
110074	0.60 (.28, .92) 10	0.26 (0, 0.58) 10	0.41 (0.06, 0.76) 8	0.12 (0, 0.44) 10	0.14 (0, 0.64) 4	0.15 (0, 0.44) 12
010075	0.19 (0, 0.60) 6	0.20 (0, 0.55) 8	0.47 (0.12, 0.82) 8	0.41 (0.09, 0.73) 10	0.21 (0, 0.71) 4	0.33 (0.04, 0.62) 12
040075	0.39 (0.07, 0.71) 10	0.56 (0.24, 0.88) 10	0.64 (0.29, 0.99) 8	0.72 (0.40, 1.04) 10	0.41 (0, 0.91) 4	0.74 (0.45, 1.03) 12
060075	0.90 (.58, 1.22) 10	1.54 (1.25, 1.83) 12	0.56 (0.21, 0.91) 8	0.42 (0.10, 0.74) 10	0.60 (0.10, 1.10)- 4	0.49 (0.20, 0.78) 12
070075	0.58 (0.26, 0.90) 10	0.54 (0.29, 0.79) 16	0.49 (0.14, 0.84) 8	0.44 (0.12, 0.76) 10	0.41 (0, 0.91) 4	0.23 (0, 0.52) 12
080075	0.97 (0.65, 1.29) 10	0.50 (0.23, 0.77) 14	0.71 (0.36, 1.06) 8	0.30 (0, 0.62) 10	0.18 (0, 0.68) 4	0.32 (0.03, 0.61) 12

3-8-705

Table 3-8-237 Continued.

Silica

	MSDS (R) = 1.6558		max $\bar{x}$ = 9.08	min $\bar{x}$ = 0.68		
Date	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6
110074	5.25 (4.44, 6.06) 10	5.14 (4.33, 5.95) 10	5.30 (4.40, 6.20) 8	5.06 (4.25, 5.87) 10	5.70 (4.42, 6.98) 4	5.43 (4.69, 6.17) 12
010075	7.80 (6.76, 8.84) 6	9.08 (8.18, 9.98) 8	7.76 (6.86, 8.66) 8	7.67 (6.86, 8.48) 10	7.35 (6.07, 8.63) 4	7.61 (6.87, 8.35) 12
040075	7.87 (7.06, 8.68) 10	8.27 (7.46, 9.08) 10	5.49 (4.59, 6.39) 8	6.04 (5.23, 6.85) 10	5.75 (4.47, 7.03) 4	5.99 (5.25, 6.73) 12
060075	8.31 (7.50, 9.12) 10	9.04 (8.30, 9.78) 12	1.72 (0.82, 2.62) 8	5.21 (4.40, 6.02) 10	4.75 (3.47, 6.03) 4	5.30 (4.56, 6.04) 12
070075	8.33 (7.52, 9.14) 10	8.59 (7.95, 9.23) 16	0.68 (0, 1.58) 8	4.09 (3.28, 4.90) 10	4.93 (3.65, 6.21) 4	4.41 (3.67, 5.15) 12
080075	8.80 (7.99, 9.61) 10	8.44 (7.76, 9.12) 14	2.25 (1.35, 3.15) 8	6.26 (5.45, 7.07) 10	6.03 (4.75, 7.31) 4	5.94 (5.20, 6.68) 12

3-8-706

Table 3-8-237 Continued.

Sodium

MSDS(R) = 1751.29

max. $\bar{x}$ = 783.75min. $\bar{x}$ = 15.50

Date	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6
110074	91.60 (65.36, 117.84) 10	108.00 (81.76, 134.24) 10	582.50 (553.16, 611.84) 8	60.80 (34.56, 87.04) 10	73.50 (32.01, 114.99) 4	63.50 (39.54, 87.46) 12
010075	102.68 (68.80, 136.56) 6	112.25 (82.91, 141.59) 8	632.03 (602.69, 661.37) 8	69.20 (42.96, 95.44) 10	99.50 (58.01, 140.99) 4	71.83 (47.87, 95.79) 12
040075	84.90 (58.66, 111.14) 10	160.90 (134.66, 187.14) 10	642.50 (613.16, 671.84) 8	58.70 (32.46, 84.94) 10	90.50 (49.01, 131.99) 4	63.00 (39.04, 86.96) 12
060075	75.60 (49.36, 101.84) 10	108.58 (84.62, 132.54) 12	698.13 (668.79, 727.47) 8	15.50 (0, 41.74) 10	31.25 (0, 72.74) 4	16.17 (0, 40.13) 12
070075	81.60 (55.36, 107.84) 10	134.81 (114.06, 155.56) 16	783.75 (754.41, 813.09) 8	47.80 (21.56, 74.04) 10	42.75 (1.26, 84.24) 4	43.42 (19.46, 67.38) 12
080075	86.10 (59.86, 112.34) 10	116.86 (94.68, 139.04) 14	764.88 (735.54, 794.22) 8	61.90 (35.66, 88.14) 10	80.50 (39.01, 121.99) 4	65.75 (41.79, 89.71) 12

3-8-707

Table 3-8-237 Continued.

Dissolved Solids						
		MSDS(R) = 33201.15	max $\bar{x}$ = 2437.50	max. $\bar{x}$ = 220.50		
Date	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6
110074	772.40 (658.14, 886.66) 10	841.80 (727.54, 956.06) 10	2075.00 (1947.25, 2202.75) 8	462.70 (348.44, 576.96) 10	464.25 (283.59, 644.91) 4	475.25 (370.94, 579.56) 12
010075	770.50 (622.99, 918.01) 6	928.25 (800.50, 1056.00) 8	1945.50 (1817.75, 2073.25) 8	515.50 (401.24, 629.76) 10	615.50 (434.84, 796.16) 4	568.25 (463.94, 672.56) 12
040075	729.00 (614.74, 843.26) 10	942.10 (827.84, 1056.36) 10	2312.50 (2184.75, 2440.25) 8	486.60 (372.34, 600.86) 10	579.75 (399.09, 760.41) 4	497.33 (393.02, 601.64) 12
060075	723.30 (609.04, 837.56) 10	797.75 (693.44, 902.06) 12	2437.50 (2309.75, 2565.25) 8	220.50 (106.24, 334.76) 10	231.00 (50.34, 411.66) 4	230.17 (125.86, 334.48) 12
070075	753.60 (639.34, 867.86) 10	1020.06 (929.73, 1110.39) 16	2363.75 (2236.00, 2491.50) 8	383.70 (269.44, 497.96) 10	402.50 (221.84, 583.16) 4	387.58 (283.27, 491.89) 12
080075	776.10 (661.84, 890.36) 10	904.50 (807.93, 1001.07) 14	2375.00 (2247.25, 2502.75) 8	566.90 (452.64, 681.16) 10	534.75 (354.09, 715.41) 4	553.42 (449.11, 657.73) 12

Table 3-8-237 Continued.

Suspended Solids

MSDS (R) = 92125.98		max $\bar{x}$ = 807.92		min $\bar{x}$ = 3.13		
Date	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6
110074	22.70 (0, 213.03) 10	18.00 (0, 208.33) 10	32.75 (0, 245.55) 8	20.90 (0, 211.23) 10	20.75 (0, 321.69) 4	20.33 (0, 194.08) 12
010075	6.50 (0, 252.22) 6	3.13 (0, 215.93) 8	50.13 (0, 262.93) 8	108.90 (0, 299.23) 10	82.75 (0, 383.69) 4	72.83 (0, 246.58) 12
040075	66.50 (0, 256.83) 10	443.90 (253.57, 634.23) 10	212.63 (0.08, 425.68) 8	254.70 (64.37, 445.03) 10	136.25 (0, 437.19) 4	283.67 (109.92, 457.42) 12
060075	233.00 (42.67, 423.33) 10	807.92 (634.17, 981.67) 10	18.50 (0, 231.30) 8	144.60 (0, 334.93) 10	153.50 (0, 454.44) 4	172.17 (0, 345.92) 12
070075	88.30 (0, 277.63) 10	22.25 (0, 172.72) 16	19.13 (0, 231.93) 8	55.70 (0, 246.03) 10	96.75 (0, 397.69) 4	31.58 (0, 205.33) 12
080075	100.10 (0, 290.43) 10	153.14 (0, 314.00) 14	35.88 (0, 248.68) 8	32.40 (0, 222.73) 10	75.50 (0, 376.44) 4	26.67 (0, 200.42) 12

Table 3-8-238 Rio Blanco Oil Shale Project Aquatic Baseline Studies, confidence limits for periphyton data for each region and date mean (sequence = mean, confidence limits, and number samples).

Total Periphyton

MSDS(R) = 56,700,000		max. $\bar{x}$ = 33936.70		min. $\bar{x}$ = 725.41		
Date	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6
110075	3130.65 (0 , 6987.99) 15	4453.60 (596.26, 8310.94) 15	11127.54 (6814.91, 15440.17) 12	15910.35 (12053.01, 19767.69) 15	10224.25 (4125.26, 16323.24) 6	14839.94 (11318.69, 18361.19) 18
010075	13979.45 (7880.46, 20078.44) 6	7773.51 (3460.88, 12086.14) 12	17038.60 (8413.33, 25663.87) 3	21619.05 (17761.71, 25476.39) 15	7881.03 (1782.04, 13890.02) 6	14258.74 (10737.49, 17779.99) 18
040075	6989.57 (3132.23, 10846.91) 15	6119.66 (2262.32, 9977.00) 15	4270.94 (0 , 8583.57) 12	13309.44 (9452.10, 17166.78) 15	10695.12 (4596.13, 16794.11) 5	8927.93 (5406.68, 12449.18) 18
060075	3247.18 (0 , 7104.52) 15	2359.68 (0 , 5880.93) 18	6403.10 (2090.47, 10715.73) 12	3432.22 (0 , 7289.56) 15	2203.12 (0 , 8302.11) 6	2722.90 (0 , 6244.15) 18
070075	725.41 (0 , 4582.75) 15	5054.05 (2004.56, 8103.54) 24	2106.69 (0 , 6419.32) 12	6183.18 (2325.84, 10040.52) 15	8166.08 (2067.09, 14265.07) 6	7732.53 (4211.28, 11253.78) 18
080075	1774.09 (0 , 5631.43) 15	7966.58 (4519.25, 11373.91) 19	1993.50 (0 , 6306.13) 12	33936.70 (30079.36, 37794.04) 15	9318.02 (3219.03, 15417.01) 6	26322.65 (22801.40, 29843.90) 18

Table 3-8-238 (Continued)

Cyanophytes, Periphyton

MSDS(R) = 3,508,640.037

max. $\bar{x}$ = 3884.06min. $\bar{x}$ = 0

Date	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6
110074	327.22 (0 , 1286.77) 15	342.23 (0 , 1301.71) 15	687.38 (0 , 1767.18) 12	3374.97 (2415.42, 4334.52) 15	1310.63 (0 , 2827.80) 6	2805.06 (1929.14, 3681.02) 18
010075	74.33 (0 , 1591.50) 6	25.63 (0 , 1098.43) 12	45.00 (0 , 2190.61) 3	1717.60 (758.05, 2677.15) 15	1091.17 (0 , 2608.34) 6	3844.06 (3008.12, 4760.00) 18
040075	22.67 (0 , 982.22) 15	229.40 (0 , 1188.95) 15	112.75 (0 , 1185.55) 12	740.13 (0 , 1699.68) 15	1327.33 (0 , 2844.50) 6	651.06 (0 , 1527.00) 15
060075	12.67 (0 , 972.22) 15	0.11 (0 , 876.05) 18	566.17 (0 , 1638.97) 12	500.00 (0 , 1459.55) 15	310.50 (0 , 1827.67) 6	225.28 (0 , 1101.22) 18
070075	0.00 (0 , 959.55)	62.25 (0 , 820.84)	186.00 (0 , 1258.80)	1894.33 (934.78, 2853.88)	3374.50 (1857.33, 4891.67)	2648.33 (1772.39, 3424.27)
080075	1.33 (0 , 960.88)	159.42 (0 , 1012.00)	35.92 (0 , 1108.72)	1075.40 (115.85, 2034.95)	1650.00 (132.83, 3167.17)	657.03 (0 , 1532.97)

3-8-711

Table 3-8-238 (Continued)

Chlorophytes, Periphyton

MSDS(R) = 15856.574

max. $\bar{x}$ = 172.64min. $\bar{x}$ = 0

Date	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6
110074	3.83 (0 , 68.36) 15	166.03 (101.97, 231.03) 15	3.38 (0 , 75.52) 12	18.00 (0 , 82.53) 15	0.00 (0 , 102.03) 6	0.00 (0 , 58.90) 18
010075	34.21 (0 , 136.24) 6	0.81 (0 , 72.95) 12	1.33 (0 , 145.62) 3	172.64 (108.11, 237.17) 15	0.00 (0 , 102.03) 6	5.55 (0 , 64.45) 18
040075	33.40 (0 , 97.93) 15	0.08 (0 , 64.61) 15	0.00 (0 , 72.14) 12	60.31 (0 , 124.84) 15	0.00 (0 , 102.03) 6	23.73 (0 , 82.63) 18
060075	24.94 (0 , 89.47) 15	0.07 (0 , 58.97) 18	0.00 (0 , 72.14) 12	15.73 (0 , 80.26) 15	2.33 (0 , 104.36) 6	3.00 (0 , 61.90) 18
070075	0.00 (0 , 64.53) 15	1.46 (0 , 52.47) 24	0.85 (0 , 72.99) 12	5.66 (0 , 70.19) 15	0.67 (0 , 107.70) 6	53.11 (0 , 112.01) 18
080075	5.60 (0 , 70.13) 15	5.21 (0 , 62.54) 19	0.91 (0 , 73.05) 12	44.93 (0 , 109.46) 15	0.00 (0 , 102.03) 6	2.83 (0 , 61.73) 18

Table 3-8-238 (Continued)

Chrysophytes, Periphyton

MSDS(R) = 51,740,000

max. $\bar{x}$ = 32816.37 min. $\bar{x}$ = 725.41

Date	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6
110074	2798.67 (0 , 6483.43) 15	3944.87 (260.11, 7629.63) 15	10436.79 (6317.10, 14556.58) 12	12517.38 (8832.02, 16202.14) 15	8913.63 (3087.51, 14739.75) 6	12032.98 (8669.27, 15396.69) 18
010075	13870.90 (8044.78, 19697.02) 6	7747.06 (3627.37, 11866.75) 12	16992.27 (8752.90, 25231.64) 3	19728.81 (16044.05, 23413.57) 15	6789.86 (963.74, 12615.98) 6	10369.14 (7005.43, 13732.85) 18
040075	6933.51 (3248.75, 10618.27) 15	5890.18 (2205.42, 9574.94) 15	4158.19 (38.50, 8277.88) 12	12509.00 (8824.24, 16193.76) 15	9367.79 (3541.67, 15193.91) 6	8253.14 (4889.43, 11616.85) 18
060075	3209.58 (0 , 6894.34) 15	2359.49 (0 , 5723.20) 18	5836.94 (1717.25, 9956.63) 12	2916.44 (0 , 6601.20) 15	1890.29 (0 , 7716.41) 6	2494.63 (0 , 5858.34) 18
070075	725.41 (0 , 4410.17) 15	4990.34 (2077.28, 7903.40) 24	1919.84 (0 , 6039.53) 12	4283.18 (598.42, 7967.94) 15	4790.92 (0 , 10617.04) 6	5031.09 (1667.38, 8394.80) 18
080075	1767.16 (0 , 5451.92) 15	7781.95 (4507.95, 11055.95) 19	1956.67 (0 , 6076.36) 12	32816.37 (29131.61, 36501.13) 15	7668.02 (1841.90, 13494.14) 6	25662.79 (22299.08, 29026.50) 18

3-8-713

Table 3-8-239 Rio Blanco Oil Shale Project Aquatic Baseline Studies, confidence limits for phytoplankton data for each region and date mean (sequence = mean, confidence limits, and number samples).

Total Phytoplankton

MSDS(R) = 7,974,806.54

max. $\bar{x}$ = 7592.36

min $\bar{x}$ = 345.67

Date	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6
110076	345.67 (-1426.08, 2117.42) 10	865.27 (0 , 2637.02) 10	760.59 (0 , 2741.46) 8	350.30 (0 , 2122.05) 10	528.46 (0 , 3326.84) 4	582.21 (0 , 2199.59) 12
010075	842.81 (0 , 330.13) 6	976.10 (0 , 2956.97) 8	667.74 (0 , 268.61) 8	1505.04 (0 , 3485.91) 8	1569.73 (0 , 4371.11) 4	1595.02 (0 , 3882.34) 6
040075	1080.05 (0 , 2947.64) 9	233.68 (559.93, 4103.43) 10	769.16 (668.29, 4630.03) 8	1887.29 (115.54, 3659.04) 10	1356.38 (0 , 4157.76) 4	2013.68 (396.30, 3631.06) 12
060075	739.11 (0 , 2510.86) 10	1439.85 (0 , 3057.23) 12	7592.36 (5611.49, 9573.23) 8	868.10 (0 , 2639.85) 10	1099.89 (0 , 3901.27) 4	659.17 (0 , 2276.55) 12
070075	785.47 (0 , 2557.22) 10	900.75 (0 , 2301.44) 16	1101.82 (0 , 3082.69) 8	584.15 (0 , 2355.90) 10	522.82 (0 , 3324.20) 4	568.70 (0 , 2186.08) 12
080075	1007.36 (0 , 2779.11) 10	4923.79 (3426.39, 6421.19) 14	786.16 (0 , 2767.03) 8	767.38 (0 , 2539.13) 10	876.60 (0 , 3677.98) 4	869.13 (0 , 2486.51) 12

Table 3-8-238 (Continued)

Chrysophytes, Periphyton

MSDS(R) = 51,740,000

max. $\bar{x}$ = 32816.37 min. $\bar{x}$ = 725.41

Date	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6
110074	2798.67 (0 , 6483.43) 15	3944.87 (260.11, 7629.63) 15	10436.79 (6317.10, 14556.58) 12	12517.38 (8832.02, 16202.14) 15	8913.63 (3087.51, 14739.75) 6	12032.98 (8669.27, 15396.69) 18
010075	13870.90 (8044.78, 19697.02) 6	7747.06 (3627.37, 11866.75) 12	16992.27 (8752.90, 25231.64) 3	19728.81 (16044.05, 23413.57) 15	6789.86 (963.74, 12615.98) 6	10369.14 (7005.43, 13732.85) 18
040075	6933.51 (3248.75, 10618.27) 15	5890.18 (2205.42, 9574.94) 15	4158.19 (38.50, 8277.88) 12	12509.00 (8824.24, 16193.76) 15	9367.79 (3541.67, 15193.91) 6	8253.14 (4889.43, 11616.85) 18
060075	3209.58 (0 , 6894.34) 15	2359.49 (0 , 5723.20) 18	5836.94 (1717.25, 9956.63) 12	2916.44 (0 , 6601.20) 15	1890.29 (0 , 7716.41) 6	2494.63 (0 , 5858.34) 18
070075	725.41 (0 , 4410.17) 15	4990.34 (2077.28, 7903.40) 24	1919.84 (0 , 6039.53) 12	4283.18 (598.42, 7967.94) 15	4790.92 (0 , 10617.04) 6	5031.09 (1667.38, 8394.80) 18
080075	1767.16 (0 , 5451.92) 15	7781.95 (4507.95, 11055.95) 19	1956.67 (0 , 6076.36) 12	32816.17 (29131.61, 36501.13) 15	7668.02 (1841.90, 13494.14) 6	25662.79 (22299.08, 29026.50) 18

Table 3-8-239 Rio Blanco Oil Shale Project Aquatic Baseline Studies, confidence limits for phytoplankton data for each region and date mean (sequence = mean, confidence limits, and number samples).

Total Phytoplankton

MSDS(R) = 7,974,806.54

max. $\bar{x}$ = 7592.36

min $\bar{x}$ = 345.67

Date	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6
110076	345.67 (-1426.08, 2117.42) 10	865.27 (0 , 2637.02) 10	760.59 (0 , 2741.46) 8	350.30 (0 , 2122.05) 10	528.46 (0 , 3326.84) 4	582.21 (0 , 2199.59) 12
010075	842.81 (0 , 330.13) 6	976.10 (0 , 2956.97) 8	667.74 (0 , 268.61) 8	1505.04 (0 , 3485.91) 8	1569.73 (0 , 4371.11) 4	1595.02 (0 , 3882.34) 6
040075	1080.05 (0 , 2947.64) 9	2331.68 (559.93, 4103.43) 10	2649.16 (668.29, 4630.03) 8	1887.29 (115.54, 3659.04) 10	1356.38 (0 , 4157.76) 4	2013.68 (396.30, 3631.06) 12
060075	739.11 (0 , 2510.86) 10	1439.85 (0 , 3057.23) 12	7592.36 (5611.49, 9573.23) 8	868.10 (0 , 2639.85) 10	1099.89 (0 , 3901.27) 4	659.17 (0 , 2276.55) 12
070075	785.47 (0 , 2557.22) 10	900.75 (0 , 2301.44) 16	1101.82 (0 , 3082.69) 8	584.15 (0 , 2355.90) 10	522.82 (0 , 3324.20) 4	568.70 (0 , 2186.08) 12
080075	1007.36 (0 , 2779.11) 10	4923.79 (3426.39, 6421.19) 14	786.16 (0 , 2767.03) 8	767.38 (0 , 2539.13) 10	876.60 (0 , 3677.98) 4	869.13 (0 , 2486.51) 12

Table 3-8-239 (Continued)

Cyanophytes, Phytoplankton

MSDS(R) = 732,300.224		max. $\bar{x}$ = 1326.67		min. $\bar{x}$ = 0			
Date	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6	
110074	13.83 (0 , 550.72) 10	46.23 (-490.66, 583.12) 10	25.14 (0 , 625.40) 8	6.67 (0 , 543.56) 10	9.48 (0 , 858.38) 4	19.85 (0 , 509.96) 12	
010075	32.50 (0 , 725.62) 6	0.00 (0 , 600.26) 8	1.00 (0 , 601.26) 8	29.71 (0 , 629.97) 8	28.25 (0 , 877.15) 4	30.20 (0 , 723.32) 6	
040075	82.09 (0 , 648.02) 9	168.61 (0 , 705.50) 10	8.89 (0 , 609.15) 8	182.16 (0 , 719.05) 10	81.29 (0 , 930.19) 4	117.27 (0 , 607.38) 12	
060075	105.60 (0 , 542.49) 10	442.84 (0 , 932.95) 12	43.05 (0 , 643.31) 8	105.20 (0 , 642.09) 10	690.75 (0 , 1539.65) 4	196.42 (0 , 686.53) 12	
070075	119.30 (0 , 656.19) 10	89.59 (0 , 514.04) 16	32.83 (0 , 633.09) 8	35.40 (0 , 572.29) 10	39.75 (0 , 888.65) 4	50.95 (0 , 541.06) 12	
080075	10.82 (0 , 547.71) 10	1326.67 (872.91, 1780.43) 14	75.25 (0 , 675.51) 8	9.10 (0 , 545.99) 10	17.18 (0 , 866.08) 4	15.93 (0 , 506.04) 12	

3-8-715

Table 3-8-239 (Continued)

Chlorophytes, Phytoplankton

MSDS(R) = 152,208.514

max. $\bar{x}$ = 674.54min. $\bar{x}$ = 5.93

Date	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6
110074	18.24 (0 , 263.01) 10	59.84 (0 , 304.61) 10	49.32 (0 , 322.98) 8	24.05 (0 , 268.82) 10	29.27 (0 , 416.29) 4	43.35 (0 , 266.79) 12
010075	40.71 (0 , 356.71) 6	31.03 (0 , 304.69) 8	19.81 (0 , 293.47) 8	83.74 (0 , 357.40) 8	92.15 (0 , 479.17) 4	60.51 (0 , 376.51) 6
040075	207.97 (0 , 465.98) 9	259.08 (14.31, 603.85) 10	160.52 (0 , 434.18) 8	166.48 (0 , 411.25) 10	118.12 (0 , 505.14) 4	186.56 (0 , 410.00) 12
060075	134.63 (0 , 379.40) 10	129.17 (0 , 352.61) 17	674.54 (400.88, 948.20) 8	172.60 (0 , 417.37) 10	70.50 (0 , 457.52) 4	86.31 (0 , 309.75) 12
070075	26.95 (0 , 271.72) 10	24.51 (0 , 218.02) 16	29.38 (0 , 303.04) 8	21.14 (0 , 265.91) 10	23.03 (0 , 410.05) 4	22.45 (0 , 245.89) 12
080075	35.89 (0 , 280.66) 10	458.10 (251.23, 664.97) 14	36.12 (0 , 303.78) 8	5.93 (0 , 250.70) 10	32.64 (0 , 419.66) 4	13.64 (0 , 237.08) 12

Table 3-8-239 (Continued)

Chrysophytes, Phytoplankton

MSDS(R) = 1,928,403.538

max. $\bar{x}$ = 6767.90min. $\bar{x}$ = 296.89

Date	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6
110074	307.16 (0 , 1178.41) 10	742.29 (0 , 1613.54) 10	676.49 (0 , 1650.58) 8	312.86 (0 , 1184.11) 10	482.51 (0 , 1860.08) 4	512.68 (0 , 1308.02) 12
010075	749.60 (0 , 1874.38) 6	932.67 (0 , 1906.16) 8	644.44 (0 , 1618.53) 8	1387.22 (413.13, 2361.31) 8	1446.08 (68.41, 2823.65) 4	1497.49 (372.71, 2622.27) 6
040075	656.81 (0 , 1575.19) 9	1803.40 (932.15, 2674.65) 10	2230.76 (1256.69, 3204.78) 8	1525.75 (654.50, 2397.00) 10	1132.72 (0 , 2510.29) 4	1671.36 (876.02, 2466.70) 12
060075	427.08 (0 , 1298.33) 10	822.50 (27.16, 1617.84) 12	6767.90 (5793.81, 7741.99) 8	549.90 (0 , 1421.13) 10	296.89 (0 , 1674.46) 4	347.37 (0 , 1142.71) 12
070075	551.91 (0 , 1423.16) 10	690.63 (1.85, 1379.41) 16	913.35 (0 , 1887.44) 8	478.51 (0 , 1349.76) 10	416.04 (0 , 1793.61) 4	416.46 (0 , 1211.80) 12
080075	887.24 (15.99, 1758.49) 10	1690.31 (953.97, 2426.63) 14	638.92 (0 , 1613.01) 8	721.24 (0 , 1592.49) 10	789.79 (0 , 2167.36) 4	795.22 (0 , 1590.56) 12

3-8-717

Table 3-8-239 (Continued)

Euglenophytes, Phytoplankton

MSDS(R) = 208.409						
max. $\bar{x}$ = 18.90 min. $\bar{x}$ = 0						
Date	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6
110074	0.20 (0 , 9.26) 10	0.80 (0 , 9.86) 10	0.14 (0 , 10.27) 8	0.68 (0 , 9.74) 10	0.00 (0 , 14.32) 4	1.24 (0 , 9.51) 12
010075	0.50 (0 , 12.19) 6	1.13 (0 , 11.26) 8	0.00 (0 , 10.13) 8	0.38 (0 , 10.51) 8	0.75 (0 , 15.07) 4	1.00 (0 , 12.69) 6
040075	1.67 (0 , 11.22) 9	0.00 (0 , 9.06) 10	0.00 (0 , 10.13) 8	1.00 (0 , 10.06) 10	1.25 (0 , 15.57) 4	1.25 (0 , 9.52) 12
060075	10.60 (0 , 9.66) 10	1.50 (0 , 9.77) 12	0.38 (0 , 10.51) 8	0.00 (0 , 9.06) 10	0.00 (0 , 14.32) 4	0.07 (0 , 8.44) 12
070075	6.60 (0 , 15.66) 10	0.52 (0 , 7.68) 16	1.39 (0 , 11.52) 8	0.60 (0 , 9.66) 10	0.00 (0 , 14.32) 4	0.75 (0 , 9.02) 12
080075	18.90 (9.84, 27.96) 10	14.64 (6.99, 22.29) 14	1.00 (0 , 11.13) 8	0.31 (0 , 9.37) 10	0.00 (0 , 14.32) 4	4.75 (0 , 13.02) 12

Table 3-8-239 (Continued)

Microflagellates, Phytoplankton

MSDS(R) = 783,075.642

max. $\bar{x}$ = 1429.29min. $\bar{x}$ = 0

Date	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6
110074	0.25 (0 , 555.44) 10	0.00 (0 , 555.19) 10	0.00 (0 , 620.72) 8	0.00 (0 , 555.19) 10	0.00 (0 , 877.84) 4	0.50 (0 , 506.32) 12
010075	7.00 (0 , 723.75) 6	1.00 (0 , 621.72) 8	0.38 (0 , 621.10) 8	0.00 (0 , 620.72) 8	0.00 (0 , 877.84) 4	1.33 (0 , 718.08) 6
040075	127.91 (0 , 713.13) 9	94.43 (0 , 649.62) 10	184.35 (0 , 805.07) 8	10.80 (0 , 565.99) 10	23.00 (0 , 900.84) 4	23.00 (0 , 529.82) 12
060075	69.00 (436.19, 624.19) 10	38.42 (0 , 545.24) 12	104.50 (0 , 725.22) 8	38.00 (0 , 593.19) 10	34.25 (0 , 912.09) 4	25.67 (0 , 532.49) 12
070075	72.70 (0 , 627.89) 10	82.56 (0 , 521.48) 16	123.50 (0 , 744.22) 8	42.20 (0 , 597.39) 10	40.00 (0 , 917.84) 4	75.17 (431.65, 581.99) 12
080075	51.10 (0 , 609.29) 10	1429.92 (960.07, 1898.51) 14	33.88 (0 , 654.60) 8	29.60 (0 , 584.79) 10	37.00 (0 , 914.84) 4	37.09 (0 , 543.91) 12

3-8-719

Table 3-8-239 (Continued)

Cryptophytes, Phytoplankton

	MSDS(R) = 328.722			max. $\bar{x}$ = 64.63		min. $\bar{x}$ = 0	
Date	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6	
110074	5.99 (0 , 17.37) 10	16.11 (1.73, 27.49) 10	9.50 (0 , 22.22) 8	5.97 (0 , 17.35) 10	4.20 (0 , 22.19) 4	4.36 (0 , 14.74) 12	
010075	12.50 (0 , 27.19) 6	10.88 (0 , 23.60) 8	2.13 (0 , 14.85) 8	4.00 (0 , 16.72) 8	2.60 (0 , 20.49) 4	4.50 (0 , 19.19) 6	
040075	3.60 (0 , 15.59) 9	3.20 (0 , 14.58) 10	64.63 (51.91, 77.35) 8	1.10 (0 , 12.48) 10	0.00 (0 , 17.99) 4	14.25 (3.87, 24.63) 12	
060075	2.20 (0 , 13.58) 10	5.42 (0 , 15.80) 12	2.00 (0 , 14.72) 8	2.40 (0 , 13.78) 10	7.50 (0 , 25.49) 4	3.25 (0 , 13.63) 12	
070075	8.00 (0 , 19.38) 10	12.94 (3.95, 21.93) 16	1.33 (0 , 14.10) 8	6.00 (0 , 17.38) 10	4.00 (0 , 21.99) 4	2.92 (0 , 13.30) 12	
080075	3.40 (0 , 14.78) 10	4.79 (0 , 14.40) 14	1.00 (0 , 13.72) 8	1.20 (0 , 12.58) 10	0.00 (0 , 17.99) 4	2.50 (0 , 12.88) 12	

3-8-720

Table 3-8-240 Rio Blanco Oil Shale Project Aquatic Baseline Studies, confidence intervals for zooplankton data for each region and date mean (sequence = mean, confidence limits, and sample number).

Zooplankton Total Density

MSDS(R) = 23,452.40							max. $\bar{x}$ = 550.41	min. $\bar{x}$ = 30.63
Date	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6		
110074	269.99 (174.10, 365.88) 10	171.79 (75.90, 267.68) 10	110.94 (3.74, 218.14) 8	145.08 (49.19, 240.97) 10	87.03 (0, 238.64) 4	155.46 (67.93, 242.99) 12		
010075	234.40 (110.61, 358.19) 6	47.61 (0, 154.81) 8	34.71 (0, 141.91) 8	226.24 (119.04, 333.44) 8		162.81 (75.28, 250.34) 12		
040075	61.53 (0, 157.42) 10	82.81 (0, 178.70) 10	60.93 (0, 168.13) 8	107.61 (11.72, 203.50) 10	120.68 (0, 272.29) 4	134.41 (46.88, 221.94) 12		
060075	314.81 (218.92, 410.70) 10	550.41 (462.88, 637.94) 12	169.55 (62.35, 276.75) 8	72.16 (0, 168.05) 10	53.68 (0, 205.29) 4	97.50 (9.97, 185.03) 12		
070075	84.43 (0, 180.32) 10	73.81 (0, 149.62) 16	30.63 (0, 137.83) 8	90.03 (0, 185.92) 10	86.35 (0, 237.96) 4	79.75 (0, 167.28) 12		
080075	41.90 (0, 137.79) 10	66.74 (0, 147.78) 14	128.44 (21.24, 235.64) 8	237.05 (141.16, 332.94) 10	188.50 (36.89, 340.11) 4	239.06 (151.53, 326.59) 12		

Table 3-8-241 Rio Blanco Oil Shale Project Aquatic Baseline Studies, confidence limits for benthos data for each region and date mean (sequence = mean, confidence limits, number samples).

Oligochaetes

MSDS(R) = 199,872,671.70							max. $\bar{x}$ = 18258.62	min. $\bar{x}$ = 23.68
Date	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6		
110074	(445.22 0, 7713.01) 15	(1089.48 0, 8357.27) 15	(18258.62 10132.98, 26384.26) 12	(856.95 0, 12348.33) 6	(2570.85 0, 14062.23) 6			
010075	(256.10 0, 10207.93) 8	(2309.28 0, 11691.96) 9	(3775.83 0, 20027.10) 3					
040075	(9741.42 2473.63, 17009.21) 15	(6969.95 0, 14237.74) 15	(3132.81 0, 11258.45) 12	(522.60 0, 7790.39) 15	(1840.25 0, 1331.63) 6	(140.83 0, 6775.38) 18		
060075	(1859.47 0, 9127.26) 15	(754.47 0, 7389.02) 18	(638.03 0, 8763.67) 12			(0, 11533.63) 6		
070075	(6388.09 0, 13655.88) 15	(50.65 0, 5919.92) 23	(392.17 0, 8517.81) 12	(95.73 0, 8582.68) 11	(1017.90 0, 13606.08) 5	(23.68 0, 7546.56) 14		
080075	(909.83 0, 8177.62) 15	(179.23 0, 6321.63) 21	(411.78 0, 8537.42) 12	(1600.63 0, 9726.27) 12	(1517.75 0, 13009.13) 6	(634.83 0, 7261.58) 18		

Table 3-8-241 (Continued)

Gastropods

MSDS(R) = 49,495.44				max. $\bar{x}$ = 351.44	min. $\bar{x}$ = 0	
Date	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6
110074	5.25 (0, 119.62) 15	2.96 (0, 117.33) 15	0.0 (0, 127.87) 12	0.0 (0, 180.83) 6	0.0 (0, 180.83) 6	
010075	4.93 (0, 161.54) 8	0 (0, 147.65) 9	0 (0, 255.74) 3			
040075	8.44 (0, 122.81) 15	0 (0, 144.37) 15	6.03 (0, 133.90) 12	0 (0, 114.37) 15	0 (0, 180.83) 6	0 (0, 104.40) 18
060075	14.48 (0, 128.85) 15	0 (0, 104.40) 18	58.83 (0, 186.70) 12			0 (0, 180.83) 6
070075	49.47 (0, 163.84) 15	0 (0, 93.36) 23	0 (0, 127.87) 12	0 (0, 133.55) 11	0 (0, 198.09) 5	0 (0, 118.38) 14
080075	4.83 (0, 119.20) 15	0 (0, 96.66) 21	351.44 (223.57, 479.31) 12	0 (0, 127.87) 12	0 (0, 180.83) 6	0 (0, 104.40) 18

3-8-723

Table 3-8-241 (Continued)

Insecta

MSDS(R) = 323,116,188.00					max. $\bar{x}$ = 69685.47		min. $\bar{x}$ = 72.43					
Date	Region 1		Region 2		Region 3		Region 4		Region 5		Region 6	
110074	6615.26 (0, 15885.96) 15		8311.15 (0, 17551.85) 15		1493.92 (0, 11825.34) 12		2780.98 (0, 17391.81) 6		3969.55 (0, 18580.38) 6			
010075	12992.15 (338.80, 25645.50) 8		23966.15 (12036.44, 35895.84) 9		69685.47 (49022.63, 90348.31) 3							
040075	13606.37 (4365.67, 22847.07) 15		19984.45 (10743.75, 29225.15) 15		25813.62 (15482.20, 36145.04) 12		4118.40 (0, 13359.10) 15		3333.08 (0, 17943.91) 6		2798.25 (0, 11233.82) 18	
060075	2315.59 (0, 11556.29) 15		1752.22 (0, 10187.79) 18		6948.89 (0, 17280.31) 12						994.50 (0, 15605.33) 6	
070075	11123.05 (1882.35, 20363.75) 15		2049.64 (0, 9512.18) 23		870.31 (0, 11201.73) 12		115.23 (0, 10906.05) 11		109.20 (0, 16114.57) 5		72.43 (0, 9637.47) 14	
080075	6185.37 (0, 15426.07) 15		10929.89 (3120.07, 18739.71) 21		1683.30 (0, 12014.72) 12		2468.38 (0, 12799.80) 12		1693.25 (0, 16304.08) 6		2598.92 (0, 11034.49) 18	

Table 3-8-241 (Continued)

Total

MSDS(R) = 737,955,137.70

max. $\bar{x}$ = 74840.30min. $\bar{x}$ = 117.00

Date	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6
110074	(7275.87 0, 21240.86) 15	(9505.05 0, 23470.04) 15	(19829.69 4216.36, 35443.02) 12	(3654.35 0, 25734.94) 6	(6632.33 0, 28712.92) 6	(
010075	(13329.51 0, 32451.86) 8	(26485.44 8456.83, 44514.27) 9	(74840.30 43613.63, 106066.97) 3			
040075	(25032.30 11067.31, 38997.29) 15	(27226.75 13261.76, 41191.74) 15	(29659.87 14046.54, 45273.20) 12	(4738.50 0, 18703.43) 15	(5307.15 0, 27387.74) 6	(2987.83 0, 15736.06) 18
060075	(4978.81 0, 18943.70) 15	(2581.18 0, 15329.41) 18	(8218.91 0, 23832.24) 12			(1043.25 0, 23123.84) 6
070075	(19704.87 5739.88, 33669.86) 15	(2160.28 0, 13438.03) 23	(1595.82 0, 17209.15) 12	(234.00 0, 16541.59) 11	(1146.60 0, 25334.67) 5	(117.00 0, 14572.14) 14
080075	(7381.18 0, 21346.17) 15	(11134.34 0, 22936.91) 21	(2972.93 0, 18586.26) 12	(4101.50 0, 19714.83) 12	(3256.50 0, 25337.09) 6	(3266.25 0, 16014.48) 18

3-8-725

Table 3-8-242 Summary of fish catch data at the RBOSP Aquatic Baseline Study Area for the period October 1974-September 1975.

Station	Mean Values for the Five Sampling Periods with 95% Confidence Intervals			
	Total Number	Total Weight (gm)	Mean Weight per Fish (gm)	Total Species
20	4 ± 11	7 ± 18	0.5 ± 0.9	1.2 ± 2.7
21	3 ± 5	2 ± 4	0.5 ± 0.6	1.4 ± 2.1
22	56 ± 137	466 ± 1284	2 ± 5	2.8 ± 2.5
23	14 ± 8	3589 ± 5091	207 ± 236	3.0 ± 0.9
24	25 ± 22	1748 ± 2232	120 ± 150	3.2 ± 1.0
25	4 ± 3	488 ± 868	137 ± 237	1.5 ± 0.9
26	21 ± 26	590 ± 1127	99 ± 238	3.0 ± 1.2
27	40 ± 31	3139 ± 2826	58 ± 67	5.6 ± 2.3
28	59 ± 108	2916 ± 2715	158 ± 205	5.2 ± 1.4
29	59 ± 55	1841 ± 1571	43 ± 38	4.8 ± 2.2
30	14 ± 16	891 ± 858	158 ± 230	2.6 ± 1.7
31	15 ± 29	370 ± 496	118 ± 295	3.3 ± 4.2
32	20 ± 17	778 ± 868	75 ± 98	3.8 ± 1.6
33	13 ± 11	3594 ± 4361	222 ± 206	2.2 ± 1.0
34	13 ± 10	1059 ± 1067	228 ± 392	2.6 ± 1.1
35	8 ± 17	156 ± 238	31 ± 50	1.4 ± 1.7

Table 3-8-243 Rio Blanco Oil Shale Project Aquatic Baseline Studies, confidence limits for each region and date mean (sequence = mean, confidence limits and number samples).

Aluminum

	MSDS(R) = 16953086.84			max. $\bar{x}$ = 21850.00		min. $\bar{x}$ = 4100.00
Date	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6
110074	20560.00 (16903.05, 24216.95) 5	21360.00 (17703.05, 25016.95) 5	21850.00 (17761.41, 25938.59) 4	15988.89 (13263.16, 18714.62) 9	16950.00 (12861.41, 21038.59) 4	16016.67 (13656.12, 18377.22) 12
010075	8200.00 (3478.90, 12921.10) 3	13075.00 (8986.41, 17163.59) 4	9650.00 (3867.86, 15432.14) 2	4100.00 (0. , 12277.18) 1	10000.00 (1822.82, 18177.18) 1	4500.00 (0. , 12677.18) 1
040075	14590.00 (12004.15, 17175.85) 10	19380.00 (16794.15, 21965.85) 10	9837.50 (6946.43, 12728.57) 8	5910.00 (3324.15, 8495.85) 10	9350.00 (5261.41, 13438.59) 4	5725.00 (3364.45, 8085.55) 12
060075	13700.00 (11114.15, 16285.85) 10	13141.67 (10781.12, 15502.22) 12	9100.00 (6208.93, 11991.07) 8	6170.00 (3584.15, 8755.85) 10	5825.00 (1736.41, 9913.59) 4	5341.67 (2981.12, 7702.22) 12
070075	13140.00 (10554.15, 15725.85) 10	11931.25 (9886.95, 13975.55) 16	11175.00 (8283.93, 14066.07) 8	4470.00 (1884.15, 7055.95) 10	5675.00 (1585.41, 9763.59) 4	4958.33 (2597.78, 7318.88) 12
080075	11790.00 (9204.15, 14375.85) 10	10900.00 (8714.56, 13085.44) 14	8462.50 (5571.43, 11358.57) 8	5360.00 (2774.15, 7945.85) 10	9450.00 (5361.41, 13538.59) 4	5405.00 (3114.45, 7835.49) 12

3-8-727

Table 3-8-243 Continued.

Arsenic

MSDS(R) = 27.30

max. $\bar{x}$ = 96.50min. $\bar{x}$ = 2.00

Date	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6
110074	12.00 (7.36, 16.64) 5	10.00 (5.35, 14.64) 5	10.00 (4.81, 15.19) 4	12.22 (8.76, 15.68) 9	10.00 (4.81, 15.19) 11	10.00 (7.00, 13.00) 12
010075	38.67 (32.67, 44.66) 3	31.75 (26.56, 36.94) 4	96.50 (89.16, 103.84) 2	2.00 (0. , 12.38) 1	20.00 (9.62, 30.38) 1	6.00 (0. , 16.38) 1
040075	16.80 (13.52, 20.08) 10	8.90 (5.62, 12.18) 10	5.50 (1.83, 9.17) 8	5.50 (2.22, 8.78) 10	5.50 (0.31, 10.69) 4	5.75 (2.75, 8.75) 12
060075	14.80 (11.52, 18.08) 10	10.33 (7.33, 13.33) 12	6.50 (2.83, 10.17) 8	5.10 (1.82, 8.38) 10	5.25 (0.06, 10.44) 4	5.58 (2.58, 8.58) 12
070075	18.00 (14.72, 21.28) 10	8.81 (6.22, 11.40) 16	5.25 (1.58, 8.92) 8	3.30 (0.02, 6.58) 10	3.00 (0. , 8.19) 4	2.58 (0. , 5.58) 12
080075	21.50 (18.22, 24.78) 10	15.29 (12.52, 18.06) 14	5.63 (1.96, 9.30) 8	3.50 (0.02, 6.78) 10	4.00 (0. , 9.19) 4	4.08 (1.08, 7.08) 12

Table 3-8-243 Continued.

Lead		MSDS(R) = 7379.95					max. $\bar{x}$ = 186.67	min. $\bar{x}$ = 4.50
Date	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6		
110074	44.00 (0. , 120.30) 5	40.00 (0. , 116.30) 5	50.00 (0. , 135.31) 4	186.67 (129.80, 243.54) 9	10.00 (0. , 95.30) 4	15.00 (0. , 64.25) 12		
010075	25.00 (0. , 123.50) 3	37.50 (0. , 122.81) 4	18.50 (0. , 139.14) 2	11.00 (0. , 181.61) 1	22.00 (0. , 192.61) 1	14.00 (0. , 184.61) 1		
040075	16.10 (0. , 70.05) 10	11.60 (0. , 65.55) 10	6.50 (0. , 66.82) 8	5.20 (0. , 59.15) 10	6.75 (0. , 92.06) 4	4.83 (0. , 54.08) 12		
060075	14.50 (0. , 68.45) 10	14.25 (0. , 63.50) 12	7.25 (0. , 67.57) 8	4.80 (0. , 58.75) 10	4.50 (0. , 89.81) 4	4.75 (0. , 54.00) 12		
070075	17.30 (0. , 71.25) 10	15.06 (0. , 57.71) 16	11.00 (0. , 71.32) 8	5.90 (0. , 59.85) 10	6.25 (0. , 91.55) 4	6.58 (0. , 55.83) 12		
080075	18.70 (0. , 72.65) 10	15.79 (0. , 61.39) 14	8.38 (0. , 68.70) 8	6.50 (0. , 60.45) 10	10.00 (0. , 95.31) 4	7.50 (0. , 56.75) 12		

3-8-729

Table 3-8-243 Continued.

Mercury						
MSDS(R) = 490672.20			max. $\bar{x}$ = 1611.11		min. $\bar{x}$ = 34.75	
Date	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6
110074	220.00 (0. , 842.14) 5	220.00 (0. , 842.14) 5	275.00 (0. , 970.58) 4	1611.11 (1147.39, 2074.83) 9	725.00 (29.42, 1420.58) 4	233.33 (...0 , 634.92), 12
010075	398.00 (0. , 1201.18) 3	237.50 (0. , 933.08) 4	814.50 (0. , 1798.19) 2	121.00 (0. , 1512.15) 1	500.00 (0. , 1891.15) 1	488.00 (0. , 1879.15) 1
040075	72.60 (0. , 512.52) 10	49.60 (0. , 489.52) 10	51.25 (0. , 543.10) 8	54.40 (0. , 494.32) 10	48.50 (0. , 744.08) 4	54.75 (0. , 456.34) 12
060075	49.60 (0. , 489.52) 10	49.92 (0. , 451.51) 12	77.38 (0. , 569.23) 8	49.50 (0. , 489.42) 10	49.25 (0. , 744.83) 4	49.67 (0. , 451.26) 12
070075	110.00 (0. , 549.92) 10	100.00 (0. , 447.79) 16	150.00 (0. , 641.85) 8	100.00 (0. , 539.92) 10	100.00 (0. , 755.58) 4	200.00 (0. , 601.59) 12
080075	46.40 (0. , 486.32) 10	37.43 (0. , 409.23) 14	34.75 (0. , 526.60) 8	41.40 (0. , 481.32) 10	46.00 (0. , 741.58) 4	46.67 (0. , 448.26) 12

Table 3-8-243 Continued.

Nitrogen, Kjeldahl total

MSDS(R) = 827079.91							max. $\bar{x}$ = 3803.33		min. $\bar{x}$ = 170.00		
Date	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6					
110074	1398.00 (590.27, 2205.73) 5	922.00 (114.27, 1729.73) 5	1115.00 (211.93, 2018.07) 4	637.78 (35.73, 1239.83) 9	567.50 (0. , 1470.57) 4	1360.83 (839.44, 1882.22) 12					
010075	3803.33 (2760.55, 4846.11) 3	1441.00 (537.93, 2344.07) 4	1009.50 (0. , 2286.64) 2	170.00 (0. , 1976.15) 1	966.00 (0. , 2772.15) 1	677.00 (0. , 2483.15) 1					
040075	1871.20 (1300.05, 2442.35) 10	926.50 (355.34, 1497.65) 10	720.75 (82.18, 1359.32) 8	495.50 (0. , 1066.65) 10	965.25 (62.18, 1868.32) 4	622.00 (100.61, 1143.39) 12					
060075	1135.20 (564.05, 1706.35) 10	657.67 (136.28, 1179.06) 12	555.50 (0. , 1194.07) 8	272.80 (0. , 843.95) 10	228.25 (0. , 113.13) 4	250.42 (0. , 771.81) 12					
070075	1001.90 (430.75, 1573.05) 10	549.19 (97.65, 1000.73) 16	852.38 (213.81, 1490.95) 8	228.10 (0. , 799.25) 10	246.75 (0. , 1149.82) 4	268.25 (0. , 789.64) 12					
080075	1644.10 (1072.95, 2215.25) 10	427.36 (0. , 910.07) 14	300.63 (0. , 939.20) 8	458.60 (0. , 1029.75) 10	1305.50 (402.43, 2208.57) 4	517.00 (0. , 1038.39) 12					

3-8-731

Table 3-8-243 Continued.

Total Phosphate

MSDS(R) = 16398.86

max. $\bar{x}$ = 946.00min. $\bar{x}$ = 414.00

Date	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6
110074	946.00 (832.26, 1059.74) 5	866.00 (752.26, 979.73) 5	712.50 (585.34, 839.66) 4	766.67 (681.90, 851.44) 9	815.00 (687.84, 942.16) 4	789.17 (715.75, 862.59) 2
010075	757.67 (610.84, 904.50) 3	616.25 (489.09, 743.41) 4	549.50 (369.67, 729.33) 2	414.00 (159.68, 668.32) 1	558.00 (303.68, 812.32) 1	445.00 (190.68, 699.32) 1
040075	798.00 (717.58, 878.42) 10	659.90 (579.48, 740.32) 10	553.63 (463.71, 643.55) 8	589.00 (508.58, 669.42) 10	605.00 (477.84, 732.16) 4	548.42 (475.00, 621.84) 12
060075	843.90 (763.48, 924.32) 10	709.50 (636.08, 782.92) 12	600.00 (510.08, 689.92) 8	501.00 (420.58, 581.43) 10	427.00 (299.84, 554.16) 4	457.50 (384.08, 530.92) 12
070075	765.40 (684.98, 845.82) 10	655.88 (592.30, 719.46) 16	687.13 (597.21, 777.05) 8	463.30 (382.88, 543.72) 10	419.50 (292.34, 546.66) 4	430.50 (357.08, 503.92) 12
080075	886.10 (805.68, 966.52) 10	697.79 (629.82, 765.76) 14	617.63 (527.71, 707.55) 8	519.50 (439.08, 599.92) 10	787.00 (659.84, 914.16) 4	573.17 (499.75, 646.59) 12

Table 3-8-243 Continued.

Volatile Solids

MSDS(R) = 410648248.10

max. $\bar{x}$ = 95033.33min. $\bar{x}$ = 9300.00

Date	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6
110074	81860.00 (63861.79, 99856.21) 5	64180.00 (46181.79, 82178.21) 5	61975.00 (41852.39, 82097.60) 4	42566.67 (29151.60, 55981.74) 9	49950.00 (29827.39, 70072.61) 4	51808.33 (40190.54, 63426.12) 12
010075	95033.33 (71797.75, 11826.89) 3	55875.00 (35752.39, 75997.61) 4	47500.00 (19042.34, 75957.66) 2	9300.00 (0. , 49545.21) 1	42800.00 (2554.79, 83045.21) 1	17700.00 (0. , 57945.21) 1
040075	68710.00 (55983.35, 81436.65) 10	46770.00 (34043.34, 59496.65) 10	30187.50 (15958.67, 44416.33) 8	24030.00 (11303.34, 36756.65) 10	43050.00 (22927.39, 63172.61) 4	30366.67 (18748.88, 41984.46) 12
060075	51240.00 (38513.35, 63966.65) 10	36116.67 (24498.88, 47734.46) 12	27675.00 (13446.17, 41903.83) 8	15314.00 (25873.46, 28040.65) 10	13950.00 (0. , 34072.61) 4	14958.33 (3340.54, 26576.12) 12
070075	55210.00 (42483.35, 67936.65) 10	33168.75 (23107.45, 43230.05) 16	36025.00 (21796.17, 50251.83) 8	12310.00 (0. , 25036.65) 10	13277.50 (0. , 33400.11) 4	12172.50 (554.71, 23790.29) 12
080075	60340.00 (47613.35, 73066.65) 10	28164.29 (17408.30, 38920.28) 14	22225.00 (7996.17, 36454.83) 8	21468.00 (8741.35, 34194.65) 10	45400.00 (25277.39, 65522.61) 4	20994.17 (9376.38, 32611.96) 12

3-8-733

Table 3-8-243 Continued.

Zinc

MSDS(R) = 4795.40						
max. $\bar{x}$ = 188.89						
min. $\bar{x}$ = 21.00						
Date	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6
110074	80.00 (18.50, 141.50) 5	76.00 (14.50, 137.50) 5	72.50 (3.73, 141.26) 4	188.89 (143.05, 234.73) 9	87.50 (18.74, 156.26) 4	80.00 (40.30, 119.70) 12
010075	159.00 (79.59, 238.40) 3	62.00 (0. , 130.76) 4	40.00 (0. , 137.25) 2	21.00 (0. , 158.53) 1	44.00 (0. , 181.53) 1	28.00 (0. , 165.53) 1
040075	97.00 (53.51, 140.49) 10	54.70 (11.21, 98.19) 10	35.00 (0. , 83.62) 8	31.30 (0. , 74.79) 10	45.75 (0. , 114.51) 4	39.17 (0. , 78.87) 12
060075	59.00 (15.51, 102.49) 10	54.67 (14.97, 94.37) 12	33.75 (0. , 82.37) 8	31.20 (0. , 74.69) 10	24.00 (0. , 92.76) 4	24.92 (0. , 64.62) 12
070075	62.90 (19.41, 106.39) 10	43.50 (9.12, 77.88) 16	46.75 (0. , 95.37) 8	34.20 (0. , 77.69) 10	28.00 (0. , 96.76) 4	25.00 (0. , 64.70) 12
080075	58.00 (14.51, 101.49) 10	43.93 (7.17, 80.69) 14	34.88 (0. , 83.50) 8	29.60 (0. , 73.09) 10	45.25 (0. , 114.01) 4	30.58 (0. , 70.28) 12

8.4 AQUATIC INTERRELATIONSHIPS

The plant and animal associations found in a body of water are largely determined by geography and history. In a more restricted sense, they are a function of the sum of environmental conditions affecting them. Such conditions include not only the physical and chemical characteristics of the surroundings, but also the biological conditions. The intent of this section is to relate, in a general way, the occurrence of aquatic communities to the sum of environmental conditions at the RBOSP site.

The distribution and abundance of organisms in streams and their abundance are largely determined by the physical and chemical characteristics of the aquatic system. Two of the most important factors in determining the distribution and abundance of organisms in streams are the velocity of the current and the nature of the bottom substrates (which are closely related). A third factor which is of great significance to the biology of the streams of semi-arid regions is the permanency of flow. Intermittent streams are inhabited by specially adapted fauna.

The physical nature of aquatic habitats included in the RBOSP Aquatic Baseline Studies range from small, shallow spring-brooks of less than 0.3 meters (1 foot) in width and less than 2.5 centimeters (1 inch) in depth, to small shallow ponds, and to the major streams like the White River, which at times exceeded 46 meters (150 feet) in width and 1.2 meters (4 feet) in depth. Bottom substrates in these habitats range from silt and detritus to cobbles, and current velocities differ greatly among the various sampling areas. In addition, several of the small springbrooks in the study area are intermittent in nature.

Dissolved oxygen concentrations vary considerably among stations and seasons. All waters in the study area are very alkaline, particularly Yellow Creek. The relatively soluble substrates comprising the drainage produce high concentrations of dissolved materials.

Waters included in the RBOSP Aquatic Baseline Studies range from hard to very hard. All contain both carbonate and non-carbonate hardness. In Yellow Creek, magnesium occurs in greater concentrations than calcium (together, these cations are generally the major contributors to carbonate hardness), a reverse of the usual situation in most waters. The concentration of dissolved solids and of the major contributors (carbonates, sulfates, and chlorides) to dissolved solids was relatively high in all areas, but particularly so in Yellow Creek. Suspended solids concentrations were generally highest in the waters on or near Tract C-a and lowest in the headwaters. Waters of the tract area and Yellow Creek generally carried the greatest quantities of organic carbon. Waters in the tract area also contained relatively great quantities of organic nitrogen. The higher quantities of organic matter in waters on or near the tract and in Yellow Creek are likely due to greater contributions of allochthonous organic material from nearby plant communities and grazing livestock. Inorganic plant nutrients, particularly nitrogen and phosphorus, were usually found in concentrations greater than those considered limiting for the growth of algae and were often at levels considered enriching.

Of all the aquatic habitats included in the RBOSP Aquatic Baseline Studies, Yellow Creek had the most unusual and the harshest chemical conditions. In the region of Yellow Creek nearest to its confluence with the White River, both sodium and chloride concentrations approached the upper tolerance limits for freshwater fish.

In all ecosystems, the three principal kinds of organisms (decomposers, consumers, and producers), are interdependent and their relationships are trophic. In many streams and rivers the primary production which supports other trophic levels is, to a large degree, derived from sources outside the aquatic ecosystem (allochthonous). Thus, allochthonous detritus derived originally from terrestrial vegetation is of great importance to the secondary trophic level since in many systems a majority of animals at the second trophic level are detritus-feeders. In other streams, however, periphyton, or the benthic algal community, is the most important source of

fixed energy and herbivores comprise a majority of the animals at the second trophic level. However, as periphyton contains detritus (allochthonous and autochthonous) mixed with algae, protozoa, etc., the distinction between herbivorous and detritivorous secondary consumption is not easy to quantify. Thus, virtually all flowing waters have secondary trophic levels that are a combination of herbivores and detritivores, composed of benthic and planktonic invertebrates and some fish. Top trophic levels generally are composed of fish.

As noted by Cummins (1974), "the present status of our knowledge of stream ecosystem structure and function is based on a number of generalizations that have been tested to some degree primarily in woodland streams of the temperate zone." In such woodland streams a majority of the energy input (primary production) is imported from the terrestrial surroundings (allochthonous material). Because of the paucity of data concerning the role of allochthonous material in unwooded, semi-arid regions, no definitive statements can be made as to the relative importance of allochthonous material to the energy (food) supply of stream ecosystems in these regions. The waters of the present study area probably contain a considerable amount of allochthonous organic material, and this material may be an important source of energy for those ecosystems.

The major source of autochthonous primary production in the waters of the present study area is periphyton. Periphyton standing crops tended to be greatest in the White River and smallest in the waters of the headwater and tract areas. In the alkaline spring-brook habitats of the headwater and tract areas, diatoms comprised the dominant algal group in the periphyton. The most abundant taxa were Achnanthes minutissima and Navicula cryptocephala. Both of these species are considered characteristic of alkaline, periphytic habitats. In the headwaters, peak algal densities (cell densities and organic weight) occurred in December 1974 - January 1975; in the tract region, a peak in cell densities and organic weight also occurred in December 1974 - January 1975, with an additional peak in April 1975. The periphyton diversities were lowest in the headwater and the

tract regions, suggesting that the periphyton communities in these regions are less complex than those in the more permanent streams of the region. The low diversities observed in the headwaters may be attributed to the limited habitat complexity and availability of a diverse upstream seed source.

In the alkaline spring-brook habitats of the headwater and tract regions, the phytoplankton constitutes a secondary source of autochthonous primary production. The composition and species abundance of the phytoplankton of these habitats and the phytoplankton abundance indicate that the phytoplankton is primarily recruited from the periphyton. Because of the low phytoplankton abundance in the spring-brooks and the fact that the major source of phytoplankton recruitment is the periphyton, the importance of phytoplankton in autochthonous primary production is secondary to that of the periphyton.

The zooplankton fauna occurring in the spring-brook habitats of the headwater and tract areas consists primarily of species which are associated with a substrate. The bottom substrates of these spring-brooks consist of gravel, sand, and shale often covered with periphytic algae. Macrophytes were rare or absent, and their absence may account for the low abundance of littoral Rotifera and Cladocera. The dominant Crustacea in these spring-brooks included the cyclopoid Eucyclops agilis and the harpacticoid Bryocamptus hiemalis. The most important factor controlling the distribution of zooplankton taxa in these waters is temperature. The peak densities and number of species of rotifers and cladocerans occurred during the summer months. Maximum densities of the predaceous cyclopoids can be related to the increased abundance of their food, i.e., rotifers and cladocerans. The harpacticoid copepod Bryocamptus hiemalis and the rotifer Notholca were restricted to these spring-brooks during the summer but more widely distributed during winter months and were thus limited by temperature. The zooplankton fauna serves as a source of food for many benthic macro-invertebrates which are either filter feeders or predaceous. In the headwater and tract regions, species of Tanypodinae and Chironomini are the

The benthic fauna of the spring-brooks of the headwaters were similar probably due to the similarity of the chemical characteristics and substrates of the streams. The Naididae and Enchytraeidae comprised the bulk of the oligochaete population in the headwaters. The aquatic insects which occur in the spring-brooks of this area have univoltine (one generation/year) or multivoltine (more than one generation per year) life cycles. Aquatic insects which require two or three years for development have not been successful in invading these headwater habitats. Dipterans, particularly the Chironomidae and Simuliidae, were the most abundant aquatic insects in the headwater region. The feeding habits of the benthic fauna of the headwater spring-brooks range from the herbivorous Hydroptilidae (Trichoptera), which feed on periphyton to carnivorous Odonata, Plecoptera, and Chironomidae. The feeding habits of the most abundant benthic organisms are: Oligochaeta--detritus feeders; Tanypodini and Chironomini--carnivorous; Ephemeroptera--primarily herbivorous; and Simuliidae--detritus feeders.

The benthic fauna of the spring-brooks of the tract area included species with the rapid cycles and species which can easily invade new waters by various means; such as adult forms which deposit eggs, immature stages which drift downstream or actively move upstream, or by burrowing into the loose substrates (hyporheic zone) and exist in a dormant state until conditions become more suitable. Adaptations such as these enable these species to exist under the condition of intermittent flow which persists in many of the aquatic habitats of the tract area. While the densities of certain benthic taxa remained high in this region, the number of species, diversity and richness were lower than in the spring-brooks of the headwater area. The intermittent nature of many of these waters undoubtedly limits the fauna which can exist there and thus limits diversity. As in the headwaters, the Diptera, Ephemeroptera and Oligochaeta dominated the benthic fauna in the spring-brooks of the tract region.

In the headwater and tract regions, ponds and marshy areas composed the second type of aquatic habitat observed. Station 5 is a marshy seepage area which is flat and covered with sedges, watercress and other vegetation. Station 14 is a pond in which thick mats of the aquatic macrophyte Zannichellia palustris grows abundantly during the summer. Station 5 has a substrate of compacted gravel with periphyton encrusted on the gravel.

In the two ponds of the tract and headwaters, aquatic macrophytes contribute a greater portion of the autochthonous primary production than in the spring-brooks but much of this plant material is not used by primary consumers since, according to Cummins (1974), rooted aquatic macrophytes are subject to little animal feeding except at times of dieback. Periphyton is thus a major source of autochthonous primary production in the marsh and pond areas. At Station 14, periphyton cell densities were generally higher than at the other tract stations. Nitzschia denticula, a diatom, flourished in this habitat. The chemical composition of Station 14 was also slightly different from other tract stations (sulfate, magnesium, hardness and dissolved solids concentrations were higher than at other tract stations).

Phytoplankton in the ponds of the headwater and tract areas constitutes a secondary source of autochthonous primary production. In the ponds as well as the spring-brooks of the area, low phytoplankton abundance and the fact that the major source of phytoplankton appeared to be the periphyton, emphasizes the importance of periphyton.

The zooplankton fauna of Station 5 was generally similar to that of Yellow Creek. At Station 14, the dominant taxa included rotifers and crustaceans. At Station 14, the dominance of Ceriodaphnia quadrangula and the high densities of rotifers such as bdelloids, Monostyla, Lepadella, Euchlanis and other monogononts are related to the abundance of macrophytes, as their abundance is governed by the amount of suitable substrate. The zooplankton fauna at these sites include rhizopods, other protozoans, rotifers, chydorid cladocerans, harpacticoid copepods (all herbivores) and cyclopoid copepods (predominantly carnivores). As in the spring-brooks, temperature

is an important limiting factor in controlling the distribution and abundance of zooplankton in these habitats.

The benthos communities of the pond and marshy habitats differed from those of the spring-brooks. At Station 5, the increased food supply (from decaying aquatic vegetation), the substrate and higher dissolved solids concentrations contributed to the increased number of species and individuals which occurred here and not at the other headwaters. At Station 5, Tubificidae, Chironomidae, Ephemeroptera, Simuliidae, Hydroptila and Grammotaulius were abundant or common. At Station 14, the benthic community included Callibaetis, Corixidae, Dytiscidae, Chironomidae (Micropsecta) Ceratopogonidae and Anthomyiidae. The most abundant Oligochaeta included the Naididae and Enchytraeidae. The feeding habits of the dominant benthic organisms at Station 5 include: Tubificidae--detritus and bacteria; Chironomidae--carnivores or algal-detritus; Simuliidae--algal-detritus; Hydroptila and Grammotaulius--periphytic and planktonic algae; Ephemeroptera--primarily herbivorous. At Station 14, the feeding habits of the most abundant benthic organisms included: Ephemeroptera--primarily herbivorous; Chironomidae--carnivores or algal-detritus feeders; Naididae--phytophagous; other Oligochaeta--detritus feeders.

In Yellow Creek the high levels of dissolved solids and generally harsh chemical conditions limit the types of organisms which can exist in its very hard waters. Two habitat types were observed in Yellow Creek during the RBOSP Aquatic Baseline Studies. Station 19 is a pond area usually choked with growth of the alga Chara kieneri. It generally had lower water temperatures and lower concentrations of sodium, chloride, and dissolved solids but higher concentrations of sulfate and hardness than the other Yellow Creek stations. At Station 19 the major source of autochthonous primary production is the attached alga Chara kieneri and periphytic algae. Periphyton diversity was very high at Station 19, probably because of the greater number of habitats available (epiphytic, periphytic, etc.). Periphyton diversity throughout Yellow Creek was greater than in the tract or headwater regions but less than that in the White River. This is probably

due to the fact that Yellow Creek has more permanent flow and a greater number of periphyton seed sources than areas of the headwaters and tract, but less suitable substrates and harsher chemical conditions than the White River. The densities of periphyton at Station 19 were similar to those at the other Yellow Creek stations (20-22), but the species composition was different. The most abundant species at Station 19 included the alkali-philous diatoms Rhopalodia gibberula, Nitzschia denticula, Nitzschia frustulum, Navicula cryptocephala and Navicula sp. whereas those at the other stations were Achnanthes minutissima, Fragilaria vaucheriae, Cyclotella meneghiniana, Navicula pelliculosa, Cymbella affinis, and Calothrix spp. The greatest organic weight of periphyton at the Yellow Creek stations was found in May - June 1975, while the greatest cell densities were observed in December 1974 - January 1975. The higher organic weights which occurred in May - June were probably due to the occurrence of filamentous blue-green algae and species of larger diatoms.

As in the tract and headwater areas, in Yellow Creek the phytoplankton played a secondary role in autochthonous primary production. The differences in phytoplankton species composition and abundance was greater at Stations 20-22 than at Station 19. The most ubiquitous and numerous species was Cyclotella meneghiniana, a species characterized by Lowe (1974) as being periphytic, tychoplanktonic, or euplanktonic; as having an optimum pH range of 8.0 to 8.5; and as being stimulated by small amounts of salt.

The composition and abundance of zooplankton fauna also differed between Station 19 and the other Yellow Creek stations. The abundance of Chara kieneri, the lower water temperatures, and the pond configuration at Station 19 were all important to the differences in zooplankton fauna of Station 19 and the other Yellow Creek stations. The rotifer fauna of Yellow Creek was similar to that of the rest of the study area. The fauna included species characteristic of alkaline waters, and the species present (Notholca acuminata, N. squamula and Colurella adriatica) are considered tolerant of brackish water and even sea water (Remane and Schlieper, 1971).

Temperature was probably the most important factor in limiting the abundance of Notholca species in the Yellow Creek stations. Notholca is known as a cold stenotherm species which is intolerant of temperatures of 25°C or higher (Ruttner-Kolisko, 1974), although Carlin (1943) reported that in brackish water it apparently occurs in summer at high temperatures. The pond Station 19 showed little of the daily temperature fluctuations that was observed at the lower stations, and thus generally presented a more suitable habitat for Notholca species.

Throughout the year of study, the crustacean Eucyclops agilis occurred abundantly in Yellow Creek due to the continued presence of mature forms throughout the year, the species adaptability to widely changing temperatures, and its euryhaline characteristics (Rylou, 1948). Although Cladocera, in general, are restricted to freshwater areas of less than 1% salinity and so would not be expected in Yellow Creek; such species as Ceriodaphnia quadrangula, Chydorus sphaericus, and Simocephalus vetulus have been found to occur in salinities up to 4 to 5% (Remane and Schlieper, 1971). The Cladocera found in Yellow Creek are typically summer species, thus accounting for their abundance in the August - September period. The differences in the relative abundance of Cladocera among the four Yellow Creek stations may be related to the density and type of aquatic vegetation. The higher relative abundance of Pleuroxus aduncus in Stations 20-22 may be correlated to the abundance of filamentous algae in Yellow Creek in late summer (Smirnou, 1971). The dense mats of Chara at Station 19 may account for the high population density of Alona circumfimbriata, as affinities to Chara have been documented for Alona costata and Alona guttata (Quade, 1969), two species similar in size to A. circumfimbriata.

The zooplankton fauna of Yellow Creek can serve as food for many of the filter-feeding or predaceous species of benthic invertebrates. Maximum abundance of predaceous cyclopoid copepods can be related to the increased abundance of their food, i.e., the rotifers and cladocerans, during the summer.

The diversity of the benthic fauna of Yellow Creek is also limited by the harsh chemical conditions which exist there. Those species which tolerate the harsh conditions, particularly the Simuliidae and Chironomidae, occur in great abundance. The dominant organisms in the benthic community were aquatic insects (particularly Diptera) and Oligochaeta. The number of benthic species and species richness were generally highest at Station 19. Helobdella stagnalis (a leech), Lymnaea (a snail), and Hyalella azteca a freshwater scud were found almost exclusively at Station 19, while Ceratopogonidae, Simuliidae, and Nematoda were common in sampling sites on Yellow Creek. The feeding habits of the most abundant benthic organisms included Simuliidae--detritus and algal feeders; Chironomini--carnivorous; and Orthocladinae-algal or algal--detritus feeders. In general, in the Yellow Creek drainage (including the headwaters, tract, and lower Yellow Creek), opportunistic feeding, multitrophic level feeding, and changes in the niche at different life stages all contribute to the complexity of the food webs in these areas.

The primary source of autochthonous primary production in the White River was periphyton. Periphyton standing crops and species diversities were higher in the White River than in any other study area. The factors which account for the larger standing crops and higher diversities included greater current velocities, more suitable substrates, and chemical conditions which were not as severe as those in the Yellow Creek drainage. The most abundant alga in the periphyton of the White River was the diatom Epithemia sorex. Other abundant alkaliphilous taxa included Lyngbya spp., Calothrix spp., and the diatoms Nitzschia dissipata, Nitzschia frustulum, Navicula salinarum var. intermedia, Navicula cryptocephala and Amphora ovalis var. pediculus. Organic weights of periphyton were generally highest in December 1974. Maximum cell densities occurred during mid to late summer above and below the confluence with Yellow Creek but during October - November 1974 and April 1975 at the confluence with Yellow Creek.

A comparison of the periphyton above, below, and the vicinity of the Yellow Creek confluence suggests few differences attributable to Yellow Creek.

Species composition was very similar in all three areas, although cell densities were lower at the Yellow Creek confluence. This was probably due to lower current velocities and less suitable periphyton habitat.

The phytoplankton constitutes a secondary source of autochthonous primary production in the White River. The species composition and abundance of phytoplankton was generally different from that of the headwater, tract or Yellow Creek areas. The phytoplankton of the White River contained a mixture of algae derived from both periphytic and planktonic habitats. In general, phytoplankton abundance was highest during the spring but lower than that in Yellow Creek. Phytoplankton abundance was expected to be lower because of the paucity of slack-water areas and the swift currents.

The paucity of lakes, ponds, pools, and backwater areas in the White River near the study area account for the low numbers of planktonic rotifers and limnetic Crustacea in the White River. The occurrence of Cladocera such as Alona, Pleuroxus, and Chydorus in the White River was not unexpected, since forms possessing compact, rounded bodies are better able to survive the turbulence of the river. However, as is the case with rotifers, the crustacean fauna of the river is identical to that of Yellow Creek, suggesting that the river zooplankton may be the product of tributaries such as Yellow Creek. The low densities of zooplankton in the White River generally preclude its having significant importance as a food source.

The White River is characterized by a rubble substrate which provides many interstitial spaces as available habitat for benthic organisms. The benthic community of the White River was more diverse than any of the sampling areas of the Yellow Creek drainage, but densities of benthic macroinvertebrates were lower in the White River than in Yellow Creek itself. The increased diversity in the White River is due primarily to greater number of species and individuals of Ephemeroptera, Trichoptera, and Plecoptera. The major reasons for the increased benthic diversities in the White River are the increased number of habitats available, permanency and velocity of flow, and milder chemical conditions that exist in the headwaters, tract or

Yellow Creek. Aquatic insects were generally the most abundant organisms, although the Oligochaeta were the most abundant organisms during the mid-summer due to the emergence of many aquatic insects.

In the White River, the Ephemeroptera, Diptera, and Oligochaeta were the dominant groups. The most abundant Ephemeroptera included Ephemerella, Rhithrogena and Baetis. The dominant caddisflies belonged to the Hydro-psychidae. Commonly occurring Plecoptera included Isogenoides, Isoperla, and Classenia. Small numbers of several other taxa of invertebrates were also found. The Oligochaeta of the White River were dominated by Tubificidae, Naididae, and Lumbriculidae. The feeding habits of the most abundant benthic organisms includes: Ephemeroptera--herbivorous; Hydropsychidae--omnivorous; Plecoptera--opportunistic; Tubificidae--bacteria feeders; and other Oligochaeta--detritus feeders. The occurrence of opportunism, multi-trophic level feeding, and changes in the niche at different life stages all contribute to the complexity of the food web in the White River.

The greater species diversity, the increased number of species, and the high Evenness Index in the White River samples may also be due to food availability. High algal biomass is recorded from the White River and algal--detritus feeders comprise the major component of the benthic community in the White River.

The ecology of the fishes of running waters was extensively discussed by Hynes (1970). He discussed the various anatomical adaptations and breeding and feeding habits exhibited by stream fishes as well as the biotic and abiotic factors that affect stream fishes. These aspects are discussed below as they relate to the fishes that occur on the RBOSP site.

Many fishes are well adapted anatomically for life in running water. These adaptations include streamlined bodies (either round in cross section or dorsoventrally flattened) and enlarged pectoral fins. Most of the fishes at the RBOSP site have streamlined bodies, including the abundant speckled dace and flannelmouth sucker which are round in cross section. This adapta-

tion permits easier swimming in the fast-water environment. A few species of fish at the site such as the carp and red shiner have body forms characteristic of fishes of slow-flowing waters (i.e. laterally flattened). These species are introduced and are not abundant. They may never become abundant due to competition with native species that are well-adapted to the fast water environment.

The mottled sculpin is very abundant in the White River at the RBOSP site and is admirably adapted for life in fast-flowing water, although not particularly for swimming in running water. The mottled sculpin is dorsoventrally flattened and has large, muscular pectoral fins. These characteristics enable the fish to hold its position on the bottom in fast water.

Oxygen is one of the most important ecological factors affecting fish. However, Hynes (1970) points out that critically low oxygen concentrations are less a factor in running water than in still water due to the rapid reoxygenation capabilities of running water. This circumstance was borne out at the RBOSP site where oxygen concentrations in the White River were never far below saturation during the study period.

Water temperature is another environmental factor that has a bearing on the presence or absence of a given fish species at the RBOSP site. On the basis of water temperature, the White River at the RBOSP site could be characterized as a "cool water" habitat. The mottled sculpin is abundant at the site and is said by Beckman (1952) and Miller (1964) to prefer cool to cold mountain streams. The various trouts and the mountain whitefish are cold-water species and also occur at the site, but in low numbers. However the presence of other species commonly associated with warm water habitats such as carp, channel catfish, red shiner and, presumably, flannelmouth sucker suggests the intermediacy of the habitat with regard to temperature.

As a further example of the "intermediate" water temperatures at the RBOSP site, it appears that the optimum water temperatures for trout are exceeded in some years. Maximum summer water temperatures of the White River at the

RBOSP site in 1973 and 1975 were 15.3°C (Pennak, 1974) and 21.0°C (present study), respectively. These temperatures are within the preferred ranges of rainbow and brown trout (McAfee, 1966; Scott and Crossman, 1973). However, a temperature of 24°C was reported for the White River near the RBOSP site in summer, 1969 (Everhart and May, 1973). This was in excess of the upper preferred temperature of rainbow trout and at the upper preferred limit of brown trout. Therefore, the low numbers of salmonids at the site may be due, at least in part, to above optimum summer water temperatures occurring during some years.

The relationship of dissolved solids to the growth of fish, particularly trout has been much studied (Hynes, 1970). The fact that growth of trout is much greater in hard water than in soft water has been well established, but the reason for this has not been determined. The hard waters of the White River at the RBOSP site (140-340 mg/l as CaCO_3) precludes restrictions on fish growth due to dissolved salt deficiencies. The fish growth studies conducted to date (see section 8.F-4.C) have revealed no unusually low growth rates.

Although dissolved solid concentrations are high in the White River and very high in Yellow Creek (up to 919 mg/l hardness as CaCO_3 in Yellow Creek), the levels are not high enough to be deleterious to fish. McKee and Wolf (1963) reported that the limiting concentrations of dissolved solids for freshwater fish are probably in the 5,000-10,000 mg/l range. This is well in excess of the maximum values recorded for the study area. Of the ionic constituents of dissolved solids, only sodium occurred at levels that are possibly detrimental to fish. The maximum recorded value for sodium at the site (977 mg/l) occurred in lower Yellow Creek in April, 1975. Some fish mortality has been experienced at sodium levels of 500-1,000 mg/l (McKee and Wolf, 1963). However, nearly the highest levels of sodium and other dissolved solids were recorded in lower Yellow Creek during May-June, 1975, at a time when large numbers of fish were present, apparently unaffected by the relatively high concentrations of dissolved solids.

In discussing the substratum of streams, Hynes (1970) pointed out the importance of shelter to fish. For example, trout occur more abundantly where there are more hiding places. This is important regarding the RBOSP site since long stretches of the White River have little suitable shelter, such as large rocks and boulders or logs. What shelter exists is in the back channel areas (formed by islands) and, consequently, the nine trout captured to date at the RBOSP site were taken in back channel areas. This may be another factor contributing to the low numbers of trout in the study area.

The waters of the White River carry a high silt load (peak in April during present RBOSP study) that is apparently due to high alkalinities and clay content of the streamside soils in the area (Pennak, 1974). The substrate in the main channel areas of the river is free of silt but slow-flowing backwater areas have deep silt deposits. Survival of trout eggs would be improbable in this type of habitat. This is perhaps the most important reason for the low numbers of trout in the area. In contrast, the flannel-mouth sucker is well adapted to the silty conditions, having evolved in the historically turbid Colorado River, and is thus a dominant species in the study area.

Reproduction of fishes at the RBOSP site takes place in the spring or summer, with the exception of brown trout and mountain whitefish which spawn in late fall or early winter. Onset of spawning is controlled by water temperature and photoperiod (Andreasen and Barnes, 1975), and stream discharge (Hynes, 1970).

Of the common fishes at the RBOSP site, reproductive habits have been described for only fathead minnow and mottled sculpin to any extent. Spawning of mottled sculpin takes place in May or June (Hynes, 1970; Bailey, 1952) and in June possibly extending through the summer for the fathead minnow (Hynes, 1970). Both species deposit adhesive eggs on the underside of rocks or other suitable material which are then guarded from predation and/or siltation by the male. Such adaptations certainly contribute to the abundance of mottled sculpins in the study area and could possibly assist the fathead minnow in establishing itself in the area.

Information on reproductive habits of other common species is nonexistent or sketchy. The flannelmouth sucker is abundant at the RBOSP site and many other parts of the Colorado River drainage, yet reproductive biology of the species has not been reported in the literature. During the present study of the RBOSP site, it was determined from gonad examinations of flannelmouth suckers in April and June, 1975 that spawning apparently took place sometime in May or June, probably mid or late June, at water temperatures of about 12-13 C. Large numbers of young-of-year flannelmouth suckers appeared in the catch for the first time during the early September, 1975 sampling. Insufficient numbers of sexually mature bluehead suckers were taken at the RBOSP site to yield information on reproductive biology. However, Andreason and Barnes (1975) reported that bluehead suckers spawned from May through early July in the Weber River, Utah through a water temperature range of approximately 5-10 C. The preferred spawning habitat for the flannelmouth and bluehead sucker is probably relatively clear riffle areas where the eggs are partially buried in gravel during the spawning act (as with other members of the genus Catostomus-according to Hynes, 1970). The reproductive habits of the speckled dace, the most frequently captured species at the RBOSP site, have not been described in detail (Minckley, 1973). Other members of the genus Rhinichthys sometimes form nests for egg deposition. The preferred spawning habitat appears to be riffles (Minckley, 1973).

It is clear that each successful fish species at the RBOSP has its own peculiar spawning adaptations that ensure survival of eggs and young in the swift, turbid water environment. The adhesive eggs of the fathead minnow and mottled sculpin protect against displacement and the guarding males assist in keeping the eggs free of silt. The act of burying many of the deposited eggs by the suckers and probably the speckled dace precludes displacement by the current and the location (riffles) induces that the eggs will be kept clear of silt by the current.

The interaction of fish with other biological groups in the environment is most obviously manifested in the feeding habits of the fishes. Food habit studies of major species at the RBOSP study area and literature information

indicates that the species present feed primarily on benthic invertebrates, primarily immature insects of the family Chironomidae and orders Plecoptera, Ephemeroptera and Trichoptera. Hynes (1970) indicated that invertebrates constitute the most important foodstuff of running water fishes.

Although there is considerable overlap of feeding habits among the fishes, sufficient differences exist to prevent direct competition between species. Both the flannelmouth and bluehead suckers ingested immature insects. However, the May-June, 1975 stomach content analysis of bluehead suckers, in conjunction with the specially adapted mouth and intestine of this species, indicate a primarily herbivorous feeding mode; thus the classification of this species as a primary consumer. The flannelmouth suckers fed largely on immature insects and ingested significant amounts of plant material only in June and July.

Changes in fish diets with the seasons is brought about by food availability. This was illustrated by the decrease from spring to summer in immature insects and increase in algae and plant material in flannelmouth sucker stomachs following similar changes in the environment. Seasonal diet changes were also recorded for the mottled sculpin. Stoneflies of the genus Isoperla were important in the sculpin diet only in April, the only time they occurred in significant numbers in the benthos samples. Also, occurrence of hydropsychids in sculpin stomachs generally paralleled their abundance in the environment.

That diets change with the size of fish of a given species is also well established; however no attempt was made to quantify this in the present study. One obvious case of diet change with increased fish size was seen in the present study; fish first occurred in the diet of some mottled sculpin that were larger than 80 mm.

Thus, the energy utilized by the fishes of the RBOSP site is obtained through several pathways. The primary pathway probably passes from allochthonous or autochthonous organic matter to immature insects to fish. A greater

degree of complexity is introduced by the fact that aquatic insects exhibit a variety of feeding modes. The Ephemeroptera are primarily herbivorous, the Odonata and certain Chironomidae are carnivorous, the Plecoptera are omnivorous, and others are detritivorous. So although fish are generally considered secondary consumers, they could technically be considered either primary, secondary, tertiary or quaternary consumers, depending on the organisms they ingest. The most common food items found in the White River fish stomachs were Chironomidae, Baetis and Ephemerella (Ephemeroptera), Hydropsyche (Trichoptera) and, to a lesser extent, Isoperla (Plecoptera). Of these organisms, only Isoperla feeds to any extent on animal matter, making it secondary consumer.

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